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EDITORIALS

CO-OPERATIVE EDUCATION IN CONNECTION WITH CENTRAL STATIONS.

About ten years ago the co-operative principle of combining technical instruction with workshop experience was put into practice by the University of Cincinnati under the leadership of Dean Schneider of the College of Engineering. The application was first made to the manufacturing industries and among others the large electric shops participated in the movement. The development of this method and the results which have been attained are fairly well known in the college world and the success of the pioneering venture has led to its extension so that now it is a settled policy of the university. The attendance of students in the courses involved, notably those in mechanical and electrical engineering, has steadily increased and the graduates appear to feel that the combination of contact with theory and application is valuable to them.

A few years ago the central-station companies of Cincinnati and Dayton were included in the scheme and in an article on other pages of this issue Prof. A. M. Wilson indicates the development of this work and the results which have been attained. It may be that in a short article of this kind some of the features are not adequatly presented, but within the available space Professor Wilson has given an excellent outline of what has been accomplished. Those who look at the article from the salesman's viewpoint may think that the defects have been unduly emphasized, but Professor Wilson is not one to gloss over the unattractive elements of his subject in order to claim a better success than has actually been achieved.

The general success which has attended this experiment indicates that the co-operative principle is a good one and might well be applied by other institutions of learning. One great advantage which it has is that it enables the student more readily to find himself and to tell whether his chosen life work is going to be as agreeable and attractive and as well fitted to his capabilities as he had expected. Some prominent psychologists have claimed that the work for which a man is best fitted can be ascertained by an investigation of the subject which involves measurements of the reaction time to certain psychological experiments. Dean Schneider does not agree with this school of thought and maintains that a great deal more can be told, and told with greater certainty, by giving the boy a trial at some actual occupation. The results in Cincinnati certainly indicate that many students discover their fitness or unfitness for certain occupations by actually engaging in the work.

THE ELECTRON THEORY OF METALLIC CONDUCTION.

We gave a brief outline in these columns last week of the electron theory of matter and it may be of interest to follow the application of the same theory to a subject which more intimately concerns the electrician —the flow of electricity in metallic conductors.

On the basis of this theory a mass of metal in a neutral condition is to be regarded as made up of atoms composed of a nucleus, consisting of positive units of electricity intimately associated with a smaller number of electrons, and additional negative electrons which are more loosely bound together. Some of these electrons may be regarded as actually free in the sense that they, in the course of their vibrations, entirely leave the sphere of action of the nucleus and may become associated with other atoms. The atoms may thus be regarded as carrying on a continual interchange of negative electrons. Of course the constituent parts of all bodies are regarded to be in a state of agitation or vibration, the magnitude of which is proportional to the absolute temperature. When such a body is charged positively, it is to be understood that a certain number of negative electrons have been removed from it, and when it is charged negatively that a surplus of negative electrons are associated with it. If the body be subjected to an electric field, the mobile negative electrons will flow from points of lower to points of higher potential, and this flow comprises an electric current wherever the electric field is maintained. Thus, in general, an electric current consists of a flow or drift of negative electrons, but this conclusion is not universal, for under other conditions the flow of electricity may be due to the movement of positive units, as in electrolytic conduction and in the case of canal rays.

When a current flows in a metallic body the drift of the electrons is not a rapid motion, but on the contrary the velocity is very low, depending upon the current-density. With a current of 100 amperes per square centimeter the velocity is estimated to be less than one-tenth millimeter per second. The number of free electrons in a cubic centimeter of copper at room temperature has been estimated as 10^{23}. This number is of the same order of magnitude as the number of atoms in the same volume. Only a very minute proportion of these electrons are involved in the flow of ordinary currents or in the transfer of electrification when bodies are charged to any ordinary voltages or even what we regard as extremely high voltages. It can be readily shown that only a minute fraction of

the total number of electrons in a body are ever lost by it, either by tranfer of electric charge, by radio-active emission, or by emission of electrons due to high temperature.

The electron theory as generally formulated accounts for a number of phenomena but has not been able to meet all the requirements which have been made of it. From experinments which he made in 1914, Professor E. H. Hall reached the conclusion that free electrons play a much smaller part in the phenomenon of conduction than many have supposed, but have an important function in thermo-electric action.

It has been supposed by some that the mechanical forces which are observed to act upon conductors carrying currents are due to direct action upon the electrons, which, owing to their attachment to the atoms of the substance, drag the latter along with them. According to this conception, a slight displacement of the electrons with respect to the body could take place and this would give rise to a transverse electromotive force. Such a transverse electromotive force in a current-carrying conductor placed in a magnetic field has been observed, and is usually designated as the "Hall effect." According to the above theory, the Hall effect and the mechanical force should be in the same direction in all metals, but experiment shows that this is not the case. The Hall electromotive force has one direction in copper, aluminum and nickel and the opposite direction in iron, cadmium and lead; whereas the mechanical force has only been observed in one direction and must be the same in all metals in order to comply with the law of Lenz.

THE ADVANTAGES OF ELECTRIC POWER.

The characteristics of power in the electric form which make it preferable over all other forms for so many applications are the possibility of generating it at high efficiency, the simplicity and efficiency of its transmission, the economy and simplicity of its distribution, the practicability of subdividing it into small units, making possible the generation in large bulk and its application by small consumers and its high efficiency of conversion into other forms of power, especially in small quantities.

The expense and trouble of producing power in small quantities has led generally to the abandonment of efforts in this direction and the application, where it is available, of central-station energy in small factories, stores, residences, etc. It is only the large factory which can make any pretense of competing with the central station in the supplying of energy, and even here it is generally only a matter of time until the advantages of central-station supply will be recognized. But even where the large factory generates its own power, the convenience of application of the electric motor for driving individual machines has led to the adoption of electrical distribution. Motors of all sizes operate with comparatively high efficiency and at the point where power is needed, and the control cannot be improved with any other form of motive power.

It is true that energy in other forms can be supplied from a central source and used locally in small quantities. Thus the application of the heat energy of gas in operating a hot-air engine is a possible one, but the simplicity, adaptability and efficiency of this form of motive power are not to be compared with those of the electric motor.

One of the greatest advantages of electric power is the possibility of its economical transmission from the point of generation to the point of use. It is not always feasible to make use of power at the point where it is most easily generated, as, for instance, at a water fall. It is only through the transformation into electric energy that the available energy of such sources has been made useful to communities situated at a distance from the source. But even where such sources of energy are used locally, as at Niagara Falls, it is found advantageous to convert the energy into the electrical form for distribution and application electrochemically, in electric furnaces or in individual electric motors. For many of the industries at Niagara Falls energy in the electric form is an absolute necessity and at the present time there is not available sufficient quantity to meet all demands. In other words, there is a power famine. Even if the restrictions on the development of power from the Niagara River are removed, it seems possible that the development of industries at this point and the enlargement of those already located there, may make it necessary to look to other sources of power to supply these industries, and the anomalous condition may eventually develop of transmitting energy to this large source, like carrying coals to Newcastle. What makes such a contingency improbable, however, is the fact that the large electrochemical industries require very cheap power to make their processes commercial, and past experience indicates that it is only feasible to supply them by locating the factory close to the source of energy. To reach the greatest development which now seems possible to the industries already located at Niagara Falls, it seems necessary to utilize a larger proportion of the power of the famous water fall and engineering investigations indicate that this can be done without detriment to the scenic beauty if the proper measures are taken to control the flow of the water.

FIRES IN CENTRAL STATIONS.

There is a widespread belief that a power plant in which electrical energy is generated is particularly liable to suffer from conflagrations and this may be a natural association of ideas by the uninformed, who connect electricity with lightning and with the production of light and heat. That fire insurance companies should act upon the same idea does not seem to be warranted either by reason or by experience. It is a fact, however, that central stations have in the past been classed as extra hazardous risks. A committee of the Ohio Electric Light Association investigated this matter some years ago and upon the basis of experience in the State of Ohio

decided that they should be more properly classed as a preferred risk, as the losses experienced over a five-year period were found to be trivial. The premiums paid to the fire insurance companies by the central stations of that state were out of all proportion to the losses and consequently out of proportion to the risk incurred. In spite of the evidence brought forward at that time, the old-line insurance companies declined to make acceptable concessions and central stations in that state as well as others have been able to find relief only through the medium of interinsurance, which is now available in acceptable form for utility companies.

While the losses of central stations by fire have been small, they have not been entirely lacking, and a few disastrous conflagrations are upon record. Fires of minor importance also occur occasionally and the vigilance of power-plant superintendents is necessary in order to keep the hazard as small as possible. An article upon another page of this issue by Mr. H. L. Gannett points out some of the precautions which should be observed in connection with power plants and the wise manager will realize the importance of taking all possible precautions. The fact that the power plant of most central stations is never without an attendant is itself, of course, an element of safety, although this does not seem to have been recognized by insurance companies.

In reducing losses from both fire and accidents much can be done along the line of prevention by electrical companies, and notable results have already been achieved by the increased attention given to accident prevention in recent years by a number of companies. It has been found well worth while to educate employees upon this point and to keep their interest in the matter keyed up to a high pitch. One element in attaining this end is the observance of Fire and Accident Prevention Day, which has been chosen by the National Safety Council and the National Fire Protection Association for a demonstration of the need for and progress in the prevention of accidents and fires. It is notorious that this country is lavish in its contribution to avoidable losses in these two lines. The nation's toll to the fire demon is approximately 5,000 deaths a year and a property loss of $500 per minute. The deaths from accidents are far more numerous and aggregate 35,000 per year, while the injuries are estimated to affect 2,000,000 persons every year. It is recognized by experts and has been proven through the application of preventive measures that a larger proportion of losses in both classes are preventable and are due to carelessness and negligence. The Safety First movement has already done much to decrease the number of preventable accidents and similar concentration of energy is desirable for the prevention of fires. We offer the suggestion that all electrical companies interest their employees in this subject by the observance of October 9 as Fire and Accident Prevention Day.

THE SALE OF CENTRAL-STATION POWER TO STEEL MILLS.

With practically all steel mills making heroic efforts to keep abreast of the orders received, the question of power for driving various machines becomes of paramount importance. In many cases where hurried extensions and additions had to be made, it has been found that central-station service offered many advantages over isolated-plant supply. In large plants where overtime operation has taxed the facilities of the private plant, central-station service was called to the rescue, and, without an additional investment of appreciable proportions, the question of extra power was satisfactorily solved.

It has needed these abnormal conditions to focus the attention of steel engineers on the many advantages and economies of central-station service. That this attention is now being accorded was clearly indicated by the discussion at this week's convention of the Association of Iron and Steel Electrical Engineers, which was held in Chicago on September 18 to 22. A very comprehensive report was presented at this meeting by the Central-Station Committee and the discussion which took place was of great importance.

Elsewhere in this issue we reproduce a tabulation taken from this report giving the names of 51 important steel plants which are purchasing power from central-station companies, in amounts ranging from 60,000,000 kilowatt-hours per year to 500,000 kilowatt-hours. It is evidence such as this which must be presented to the engineers of steel plants if central-station service is to be given the consideration which it rightfully deserves. From the discussion referred to it was evident that a majority of the electrical engineers of steel mills are open-minded in regard to the question of power and in the final analysis have only the interests of their companies at heart.

One of the most impressive features of the discussion was the desire expressed by practically all of those who participated to obtain accurate data on the operation of their plants, so that a fair comparison can be made between the various classes of power. It is perhaps impossible to obtain all of the business of iron and steel mills, as undoubtedly many of the larger plants have power stations equally as efficient as the local public utility and in many cases can perhaps generate energy at a cost which does not permit of central-station competition. There is, however, a great field, particularly at this time, and there is undoubtedly much business that can be obtained by an intelligent analysis of conditions. It must be remembered, however, by power engineers, that the electrical engineers of iron and steel mills, who usually have the authority to decide as to the type of power, are men of an unusually high grade of intelligence, who know perhaps as much as the power salesmen concerning the central-station's business and its ability to sell power at a lower cost than can be manufactured by the steel mill. An engineering analysis of conditions must be made in every case and a report submitted that is based entirely on facts.

Happenings in the Industry

Annual Convention of the Illuminating Engineering Society—Association of Iron and Steel Electrical Engineers Discusses Central-Station Power—Meeting of N. E. L. A. Wiring Committee—Electric Vehicle Plans—State Electric Campaign for Indiana — Detailed Program of the Annual Convention of the Jovian Order

ANNUAL CONVENTION OF THE ILLUMINATING ENGINEERING SOCIETY.

President Steinmetz Opens Convention in Philadelphia with Significant Address on the Future of the Industry.

The luminous arc gives the greatest promise of any light source for improvement in efficiency, according to Charles P. Steinmetz, president of the Illuminating Engineering Society, in his annual address at the convention held in Philadelphia, September 18 to 20. The address dealt with "The Present Aspects and Future Prospects of Light Production."

In experimental work 100 lumens per watt have been reached in high-power lamps. This form of arc lamp appears to provide a direct conversion of electrical energy into light and offers room for radical advances in efficiency. The available materials are few, since most substances dissociate at the high temperatures involved. Titanium, calcium and mercury are the only elements which promise to give efficiencies higher than those obtained in the incandescent lamp. The spectra of arcs are usually obtained at atmospheric pressure. They are known to vary with conditions, however, as illustrated by mercury at low pressure and at the high temperatures and pressures obtained in a quartz tube. Conditions for high efficiency may be found.

Another possibility of high efficiency is found in electro-fluorescence. Thus the mineral willemite when excited gives out radiation which is nearly all luminous. Over 200 lumens per watt of the incident energy is obtained. The production of cathode rays is, however, inefficient and the use of ultra-violet light is out of the question. Fluorescent materials are available for giving any desired color, but we have no efficient way to apply energy to these substances.

The vacuum tube has been disappointing, as the efficiencies obtained have not been as good as with the gas-filled incandescent lamp. The latter will probably be improved somewhat, but not to any great extent, as the melting point of tungsten has been closely approached and even at that temperature the efficiency would be only twice as high as with the present lamps. The only elements with melting points higher than that of tungsten are carbon and an unknown metal which the periodic system indicates to exist. Since it is as yet undiscovered, it is probably rare and of no industrial importance.

The convention was called to order in the Bellevue-Stratford Hotel by Joseph D. Israel, chairman of the Convention Committee. After some introductory remarks he introduced Edward J. Cattell, city statistician, who, in the absence of Mayor Smith, made an address of welcome, to which Louis B. Marks responded. Mr. Israel then presented President Steinmetz. Following the presidential address, C. O. Bond presented the report of the Committee on Nomenclature and Standards. This was followed by the report of the Committee on Progress, presented by the chairman, Francis E. Cady. It was discussed by L. C. Porter, Preston S. Millar, L. B. Marks and J. R. Cravath.

At the afternoon session, held under the chairmanship of Mr. Marks and later of Vice-President Halvorson, the first paper presented was one by Henry P. Gage, entitled "Colored Glass in Illuminating Engineering." This paper considered the transmission and absorption of different parts of the spectrum by glasses of different colors and was illustrated by lantern demonstrations. The paper was discussed by Clayton H. Sharp, M. Luckiesh, F. A. Benford, S. G. Hibben, Francis C. Caldwell and L. C. Porter.

C. H. French then presented a paper by C. J. Van Gieson and himself, entitled "Gas and Electric Lighting in the Home." This paper advocated the supply of dual service in every home, giving arguments therefor and details of suitable equipment. In discussing this paper, Leon Scherck, of the Central Hudson Gas & Electric Company, said that the author's conclusions were all right if one accepted their premises, which he did not, as he considered the expense of installing both services in the home unnecessarily large for both customer and company. The paper was also discussed by W. R. Moulton, J. W. Lee, R. B. Ely, Norman Macbeth, T. J. Litle, Ward Harrison, R. L. Lloyd, G. H. Stickney, F. C. Caldwell and M. Luckiesh. The concensus of opinion seemed to be against a complete dual equipment, although the advantage of an auxiliary system of lighting was generally recognized.

The last two papers of the session were discussed together. The first of these was by J. A. Orange and was entitled "Optic Projection as a Problem in Illumination." This paper was a plea for abandoning the prevalent point-source treatment of projection in favor of a rational method of considering surface sources. The magic lantern and motion-picture machine were considered in detail. The other paper was by R. B. Chillas, Jr., and was entitled "Projection Engineering." This paper took up the production of the light and its projection on the screen to the best advantage. The characteristics of direct-current and alternating-current arcs were considered, and the best carbons for each case discussed.

These papers were discussed by F. A. Benford, L. C. Porter, H. P. Gage and P. R. Bassett. Mr. Benford told of testing an ellipsoidal mirror and getting only 80 per cent as much useful light as without it. Mr. Porter pointed out the advantages of the tungsten lamp for projection purposes. Mr. Bassett told of tests in the Strand Theater, New York City, where of 66,000 lumens produced by the lamp only about 1,500 or 2.8 per cent reached the screen. The management wants more light and is willing to pay for it, but reliability is the first consideration and consequently a vertical arc is used.

In the evening there was a reception to President Steinmetz, followed by a musicale and dance. Other entertainment features were the annual banquet on Tuesday evening and automobile trips for the ladies on Monday and Tuesday, the latter to Valley Forge. On Wednesday afternoon there was an exhibit of lighting apparatus at the University of Pennsylvania.

Tuesday Morning Session.

James R. Cravath presided at the session held on Tuesday morning. The first paper was one by C. S. Snyder and F. H. Gilpin, describing the "Gas Illumination of the Philadelphia Civic Exposition." This was followed by a paper by Frank A. Benford, Jr., entitled "The Integrating Sphere and a New Type of Compensating Screen." This paper discussed certain corrections and proposed the use of a special screen for securing more accurate results. The paper was discussed by Clayton H. Sharp, F. C. Caldwell,

Preston S. Millar and F. E. Cady. Dr. Sharp pointed out that while these corrections are not important with a large sphere, the method proposed was valuable and would make work with small spheres more accurate.

L. J. Lewinson then presented a paper entitled "The Interpretation of Forced-Life Tests of Incandescent Electric Lamps." This paper showed the advantages of testing incandescent lamps at wattages higher than normal in order to shorten the time of life test. Forced tests involve correction factors which are usually expressed as an exponent of the watts per candle according to which the life varies. The proper values of this exponent were considered for different sizes of lamps. To use forced tests correctly the characteristics of the lamp and the manufacturing conditions must be well known.

This paper was discussed by George W. Middlekauff, L. G. Jarrett, W. M. Skiff, J. L. Minick and Preston S. Millar.

Dr. Middlekauff said that the Bureau of Standards has been using forced tests and applying the exponent 7.4. Good agreement with normal tests was found on the medium sizes of lamps. On smaller lamps a lower exponent applies. The number of lamps used for a test should be large. No difference was found in the value of the exponent of burned-out lamps and those whose useful life was ended by reaching 80 per cent of original candlepower. Mr. Jarrett said that three laboratories had found values from 6.7 to 6.9 for small lamps, whereas Mr. Lewinson used 6.1. Mr. Skiff said that it had not been found satisfactory to use the forced-life test on gas-filled lamps with coiled filaments. Mr. Minick emphasized the value of rapid testing to large consumers of lamps as well as to the manufacturers. Mr. Millar said that the results of forced tests should only be accepted with caution and after confirmation by normal tests.

W. G. Houskeeper then presented a paper entitled "An Application of Probability to Inspection." This considered the applicability of the theory of probability and the well known probability curve to determining the distribution of variation of any quality of a product from the normal. He has applied this to the current, resistance and candlepower of incandescent lamps, but has not found it suitable to the watts per candle. He has not applied it to life tests.

This paper was discussed by B. T. Fisher, L. J. Lewinson and C. H. Sharp. Mr. Lewinson considered the application to life tests. Experiments which were described in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, June 10, 1916, page 1062, showed that a large number of lamps were necessary to secure accurate results. To come within 10 per cent of the result obtained with 300 lamps, at least 15 were needed.

The discussion of the report of the Committee on Nomenclature and Standards, which had been deferred from the first session, was then taken up. This report was discussed by Clayton H. Sharp, M. Luckiesh, L. T. Troland and George A. Hoadley.

Tuesday Afternoon Session.

A scientific session was held on Tuesday afternoon under the chairmanship of E. P. Hyde and M. G. Lloyd. The first paper was that by L. T. Troland, of Cleveland, entitled, "Apparent Brightness: Its Conditions and Properties." This was a theoretical discussion of brightness from the psychological and physiological points of view. The paper was discussed by P. G. Nutting, of Rochester.

The paper entitled "Effects of Brightness and Contrast on Vision" was then presented by P. G. Nutting, of Rochester. This paper considered especially the lowest perceptible brightness, the faintest perceptible contrast and the highest comfortable brightness, giving data over the whole visual range. The discrimination factor was introduced as a measure of seeing quality.

This paper was discussed by C. E. Ferree, M. Luckiesh, Ward Harrison, Francis C. Caldwell, J. R. Cravath and L. T. Troland.

F. C. Caldwell, of Columbus, then presented his paper entitled, "The Effect of Brightness of Light Source on General Illumination." This paper compared installations of direct and indirect lighting and showed that the several observers required higher measured illumination under the latter to give the same brightness impression as with the former.

This paper was discussed by Norman Macbeth, S. G. Hibben, J. L. Minick and M. G. Lloyd.

A paper entitled "Experiments on the Eye with Pendent Reflectors of Different Densities and Designs," by C. E. Ferree and G. Rand, was then presented by Dr. Ferree. This continued the previous series of papers by the same authors in which eye fatigue is measured under different systems of illumination. Inverted diffusing reflectors of six types were used and the greatest fatigue found to accompany the high brilliancies.

The paper was discussed by J. R. Cravath, F. C. Caldwell, R. Ff. Pierce, M. Luckiesh, George A. Hoardley and G. Rand. Mr. Cravath pointed out that the results in this series were inferior to those of previous installations with lower brightness. Mr. Pierce judged that a brightness over 1.25 candlepower per square inch produces fatigue and any system over two candlepower is to be avoided. Dr. Rand fixed the limit at 1.8 for good results. In closing the discussion Dr. Ferree stated he was not sure that any limit could be fixed to apply in all cases, since the dimensions of the room and other fixtures affect the result.

The annual banquet was held on Tuesday evening at which Charles P. Steinmetz, president of the Society, delivered a very interesting address. He then turned the chair over to Edward J. Cottell, who acted as toastmaster. Speeches were delivered by Joseph B. McCall, William H. Gartley and William J. Serrill.

The banquet concluded with the award to the Chicago Section of the prize for the best attendance, distance and total membership being considered. There were 16 members of the Section present. The total registration at the convention was 437, breaking all previous records.

Final Session.

The final session on Wednesday morning was held with President Steinmetz and C. L. Law occupying the chair. The first paper was by H. L. Jenkins and G. W. Roosa, entitled "Recent Developments in Prismatic Glassware," and was devoted to a description of some novel types. The paper was discussed by Ward Harrison and R. Ff. Pierce.

The next paper, entitled "Reflectors for Glass Bowls," by J. L. Stair and J. A. Hoeveler, described units combining a mirrored reflector for the indirect element with a diffusing element for controlling the direct light from the bowl. The paper was discussed by W. R. Moulton, Norman Macbeth, J. R. Cravath, Samuel G. Hibben, E. P. Hyde, C. P. Steinmetz and George H. Stickney.

E. P. Hyde then presented the report of the Committee on Lighting of which he was chairman, which was submitted to the Building Committee of the Cleveland Museum of Art, and he illustrated the results achieved by means of lantern slides. This report was discussed by G. H. Stickney, W. O. Morrow, M. Luckiesh, Ward Harrison, Clayton H. Sharp, R. W. Myers, J. L. Stair, S. G. Hibben and R. Ff. Pierce.

The final paper of the session was entitled "Studies of Economics in Office Building Lighting." It was presented by S. G. Hibben. This paper considered wiring fixtures, upkeep and other details and compared results with dif-

ferent types of equipment. Figures for maintenance were also given. The paper was discussed by J. R. Cravath, E. A. Anderson, W. R. Moulton and Ward Harrison.

The reports of the committees on the presidential address and resolutions were presented by G. A. Hoadley and James R. Cravath and were adopted. President Steinmetz then introduced W. J. Serrill, president-elect of the Society, who pointed out the different viewpoints of the purposes and ideals of the Society and the need for providing for the unscientific portion of the membership, as by a correspondence course of instruction. He stated that the finances of the organization were in a sound condition.

On Wednesday evening the lecture course was formally opened by addresses made in the Museum Building of the University of Pennsylvania. Provost Edgar F. Smith presided, and addresses were made by President Steinmetz; by E. P. Hyde, chairman of the Committee on Lectures; and by William A. Durgin, of Chicago. The latter address was on "Controlled Light and the Satisfactions of Life" and was accompanied by demonstrations.

IRON AND STEEL ENGINEERS DISCUSS CENTRAL-STATION POWER PROBLEMS.

Operating Records, Motor Costs and Upkeep and Other Problems Considered at Chicago Convention.

The report of the Central-Station Power Committee and the attendant discussion proved to be the most interesting features of the opening sessions of the tenth annual convention of the Association of Iron and Steel Electrical Engineers, held at the Hotel La Salle, Chicago, Ill., September 18-22. The committee made an investigation of the extent to which the use of central-station power can be made advantageously in the development of steel-mill economies, determining conditions of operation in order to make comparisons with steam and other forms of drive. The report submitted was notable in the amount of data given regarding power costs and economies, and comparisons between the costs of purchased power and that generated by steel-mill plants.

The sessions of the convention began Monday morning, September 18. Following the registration of members, which indicated a total attendance of about 300, the first session was called to order by President W. T. Snyder, of McKeesport, Pa. After the president's address, reports were made by officers and standing committees. The report of the Safety Committee recommended the use of inclosed switches, gave specifications for a lineman's safety belt, and recommended 275 volts as the limiting voltage in steel-mill operation, with the possible exception of higher voltages in isolated installations and on large apparatus. Walter Greenwood, of Youngstown, O., read a paper on safety regulations, which was followed by discussion of the subject by D. M. Petty, of South Bethlehem, Pa.; S. C. Coey, of Youngstown, O.; C. E. Bedell, of Wheeling, W. Va., and T. E. Tynes, of Lackawanna, N. Y.

Secretary W. O. Oschmann, of Pittsburgh, Pa., read the results of a letter ballot on the election of officers, and the following were declared elected: President, F. D. Egan, Midland, Pa.; first vice-president, C. A. Menk, Munhall, Pa.; second vice-president, S. C. Coey, Youngstown, Pa.; treasurer, James Farrington, Steubenville, O., and secretary, J. F. Kelly, McKeesport, Pa.

The Monday afternoon session was opened with a paper on "The Value of Records to an Operating Engineer," by R. S. Huey, of the Universal Portland Cement Company, Duluth, Minn. The necessity of records to solve cost problems was first emphasized. Local manufacturing conditions make methods of recording data different, so there can be no standard to suit all conditions, and the operating engineer must work out forms to suit his particular needs. To be of value records must be accurate and should be automatic in their compilation—a part of the every-day routine of work. Methods of keeping and applying records were described by the author, who, in closing, gave a warning of the danger of keeping too many records. The question to be decided is what records are of enough value so that the information derived will warrant the expense of keeping them. In the discussion, F. A. Wiley, of South Chicago, Ill., brought out the importance and economy of shop order and record systems. Ludwig Hommell, of Pittsburgh, Pa., commented on the use of records in calculating power costs and the distribution of these costs. C. S. Lankton, of Pittsburgh, said records secure the cooperation of departments and systematize operations. President Snyder spoke of the necessity of checking records. A. G. Pierce, of Pittsburgh, pointed out the futility of extreme accuracy in records, and also said records on apparatus should consider operating conditions and not merely length of service. T. E. Tynes brought out good points by saying that all records should be dated, that proper units should be used in making comparisons, and that records prove valuable after changes in the personnel of an organization had been made. Others participating in the general discussion were Brent Wiley, of the Westinghouse Electric & Manufacturing Company; J. F. Kelly, of McKeesport, Pa.; Paul Caldwell, of the General Electric Company; F. H. Woodhull, of Coatesville, Pa.; L. F. Galbreath, of Brackenridge, Pa.; C. S. Ripley, of Cleveland, O.; C. E. Bedell; F. D. Egan; C. A. Menk; and G. W. Richardson, of Pencoyd, Pa.

The second paper presented Monday afternoon was on "Cost Versus Upkeep of Direct-Current Motors," by A. M. MacCutcheon, of the Reliance Electric & Engineering Company. In order to give increases in cost resulting from increases in the quality of a motor the author expressed the increases as percentages of the total cost of the motor, a 15-horsepower motor being selected as typical. Thus, if a steel-mill engineer requires a reduction of 5 degrees in the heating of the shunt fields of this typical motor the extra material means an increase of 1.3 per cent of the total cost. The use of roller bearings would increase the cost 4 per cent; increase of one-eighth of an inch in commutator wearing-depth, 0.4 per cent, and so on, a large number of points of quality being evaluated. In the discussion, James Farrington stated that the first cost of a motor should not be the determining factor if it was to be used 80 per cent of the time, as some steel-mill motors are. F. B. Crosby, of the General Electric Company, spoke of the relations of the designing engineer and the operating engineer with the purchasing department as an intermediate factor which sometimes hampered relations. C. S. Lankton spoke of the undesirability of one kind of motor for operation, say, 80 per cent of the working day, and another for 50 per cent, because too many types are required. J. E. N. Hume, of the General Electric Company, stated the changes in motor design were due to necessary improvements and to meet competition. Others discussing the paper and the subject were R. B. Treat, of the Crocker-Wheeler Company; L. F. Galbreath; J. C. Reed, of Steelton, Pa.; D. M. Petty, T. E. Tynes, C. E. Bedell and G. W. Richardson.

The first paper to be presented at the Tuesday morning session was the report of the Central-Station Power Committee, which was read by R. L. Baker, of Chicago, Ill. This report consisted of various subjects on central-station power, each subject being handled by individual members of the committee. The advantages of central-station power over steel-plant generation was considered by D. B. Rushmore, of the General Electric Company; power costs, by R. L. Baker; rates and contracts, by E. T. Selig, of New

York City; characteristics of steel-plant loads, by Joseph McKinley, of Pittsburgh; statistical data on the use of purchased power by steel companies, by Brent Wiley, of the Westinghouse Electric & Manufacturing Company; and applications of central-station power to steel mills, by T. E. Tynes. Each of these subjects was considered in detail, there being given analyses of power-plant costs and relative costs; tables of central-station power rates; curves of steel-mill loads; a list of steel companies using central-station power, and other data. The use of central-station power for electric furnaces was also considered. The report, in its entirety, presents a good review of the conditions affecting the use of central-station power in the steel industry. In discussing the report F. D. Egan gave additional points on the economy of central-station power and on the cost of power. J. C. Reed cited the difficulties encountered in buying power from a small company and losses in changing 25-cycle to 60-cycle current, and urged the standardization at 60 cycles. P. H. Stambaugh, of Youngstown, O., spoke of satisfactory operation of rolls on central-station power. S. C. Coey, of Youngstown, O., said steel-mill operators are realizing the necessity of keeping records of their power costs for comparison with costs of central-station energy. R. Tscheutscher, of South Chicago, Ill., stated that reliability of gas-engine power plants was underestimated, and their operation very satisfactory.

A joint session with the American Institute of Electrical Engineers was held Wednesday, at which the following papers were presented: "Underground Distribution Systems," by George J. Newton; "The Unaflow Engine," by W. Trinks; "Steel Conductors for Transmission Lines," by H. B. Dwight, and "The Advantages of Modern Types of Direct-Current Machines," by David Hall. On Thursday the following papers were presented: "Mechanical and Electrical Operation of the Heroult Electric Arc Furnace," by G. W. Richardson; "Operating Characteristics of an Electric Reversing Blooming Mill," by E. S. Jefferies; "Control of Direct and Alternating-Current Motors as Applied to Cranes," by Paul Caldwell, and "Portable Electric Tools as Applied to the Iron and Steel Industry," by A. M. Andresen.

Wiring Committee of N. E. L. A. Discusses Standardization of Plugs and Receptacles.

The Wiring Committee of the National Electric Light Association met in the Engineering Societies Building, New York, N. Y., on September 19. A large share of the time was occupied by a continuation of the discussion of standardization of plugs and receptacles It was decided that polarity plugs were very desirable as to bases.

R. S. Hale, chairman of the committee, reported that the matter of the color of the neutral wire had been referred to the Underwriters' Laboratories and that pleasing progress has been made.

It was urged that members of the committee do all possible to promote further trial installations of concentric wiring and it was thought that any other new systems that may appear promising should be given a fair trial.

The committee hoped that the appliance end of the portable cords could be standardized so that any portable appliance whatsoever could be attached to a given cord. Inquiries for suggestions as to how such standardization may be effected are to be sent to central stations throughout the country.

There was also a discussion of standardization of connections to electric ranges and the necessity for this was apparent to all. The committee decided that wire smaller than No. 16 should not be used in fixtures to which portable appliances are likely to be connected.

Excellent Prospects for Electric-Vehicle Business.

The first meeting of the season to be held by the Chicago Section of the Electric Vehicle Section, National Electric Light Association, was a luncheon held on September 19 at the Hotel Metropole, Chicago. George B. Foster, chairman of the Chicago Section, opened the meeting by referring to the upward trend of the electric-vehicle business. He said that one of the largest coal companies in Chicago had placed an order for 25 electric coal-delivery trucks, the first of which would be placed in service within 30 days.

The chief address of the meeting was made by E. S. Mansfield, of Boston, national chairman of the Electric Vehicle Section. He stated that the previous and present gradual growth of the electric-vehicle business has been a very healthy growth. Reviewing the history of the former Electric Vehicle Association of America, he dwelt particularly upon the advantages accruing from its recent affiliation with the National Electric Light Association. A number of special features already planned and partly executed were described. One of these is the creation of a Publicity Committee to gather items of mutual interest for publication in the monthly bulletin. It has been decided to conduct a national campaign among the 1,200 Class A member companies of the National Association to get them to purchase at least one and preferably more electric vehicles for their own use. President Wagner has started the ball rolling by ordering 25 commercial electrics for use in Baltimore. Each central station will also be urged to start an electric-vehicle department, or at least to put in its organization an electric-vehicle expert to educate the company's staff and to aid in general development of the business. An educational course on electric vehicles is to be started which will aim particularly to interest central-station employees and to give them authentic information on electric vehicles, storage batteries and other auxiliaries. A new motion-picture film on electric vehicles, especially electric fire-extinguishing apparatus, is being prepared. Representatives of the Electric Vehicle Section will be placed on the Power Sales Bureau and the Educational Bureau of the Commercial Section.

Mr. Mansfield said that earnest efforts are being made to develop a design of electric passenger car at a relatively low price for general runabout service for central stations and commercial firms. Brooklyn and Boston interests are working on cars that it is hoped to sell for something under $1,000. The plan is not to compete with present electric passenger cars, but to open up a new field as yet untouched by the electric vehicle.

Probability of Beginning Chicago Railway-Terminal Electrification.

The Illinois Central Railroad has submitted to the Railroad Terminal Committee of the Chicago City Council for approval plans for its new passenger terminal station to be erected just south and southeast of the present depot at the foot of Twelfth Street. It is intended to run the suburban trains through a tunnel or subway at least a mile long under the train shed and approach yard for the through trains. Without definitely announcing an electrification project, it is stated that this tunnel can mean only one thing—electrification of at least the suburban service of this railroad and therefore a beginning of more general electrification of Chicago railway terminals. Illinois Central electrification at Chicago has been agitated for nearly 20 years and seems finally to be brought to realization.

DETAILED PROGRAM OF THE ANNUAL CONVENTION OF THE JOVIAN ORDER.

Meeting at Indianapolis, Ind., October 18 to 20, 1916.

With Henry L. Doherty finally capitulating to the popular and insistent demand of the Jovians that he allow his name to be presented to their annual convention at Indianapolis, October 18 to 20, as a nominee for "Jupiter," the head of the Jovian Order; with his election assured by the voluntary withdrawal in his favor of all other candidates for the office; with the revision of the Jovian Constitution that is promised, making for a more efficient working instrument, that organization has in prospect an epochal year.

The annual convention of the Order offers an excellent opportunity for Jovians to prove their loyalty and their claim to the diadem of co-operation. The program embraces questions of moment to be analyzed, addresses on worth-while subjects by men capable of expounding them interestingly and instructively, and sufficient pleasing entertainment to provide intervals of necessary relaxation.

The complete program is as follows:

Tuesday, October 17.

1 P. M.

Registration. Mezzanine floor, Hotel Severin. Wives of visiting Jovians to be registered on separate cards.

8 P. M.

Concert.

Informal reception and dance. Hotel Severin, Assembly Room. Take elevator. Concert by Robbins & Myers Company's band of 40 pieces. This is said to be one of the best organizations of the kind in the country.

8:30 P. M.

Dancing. A professional orchestra will furnish dance music.

During the evening between dances the Robbins & Myers Company's band will furnish concert music.

Souvenirs will be presented to the ladies.

Wednesday, October 18.

8:30 A. M.

Registration.

10 A. M.

Formal opening of the fourteenth annual Jovian convention. Hotel Severin, Assembly Room.

Opening address by Thomas A. Wynne, Fourteenth Jupiter. Address of Welcome by Hon. Joseph E. Bell, Mayor of the City of Indianapolis.

Response by Hon. Henry W. Kiel, Mayor of the City of St. Louis.

Address by Hon. Samuel M. Ralston, Governor of the State of Indiana.

11 A. M.

Adoption of Order of Business. Reading of Mercury's annual report. Appointment of nominating and other committees.

2 P. M.

Business Session—Assembly Room, Hotel Severin.

3 P. M.

Address by M. D. Cooper, engineering department, National Lamp Works of General Electric Company, Cleveland, on "Voltage Standardization." Address by Hon. Henry Lane Wilson, Indianapolis, formerly American Ambassador to Mexico and an authority on conditions in the southern republics, on "Trade Relations with Mexico and Central America." Address by W. A. Layman, president, Wagner Electric Manufacturing Company, St. Louis on "Building a Career."

7 P. M.

Concert by Robbins & Myers Company's band of 40 pieces at "The Circle," on the steps of the "Soldiers' and Sailors' Monument."

8:30 P. M.

Indianapolis by Electric Light

Complimentary admission by tickets in coupon books to the following high-class photo-play houses: Circle Theater, Alhambra Theater, Regent Theater.

Thursday, October 19.

9 A. M.

Business Session, Assembly Room, Hotel Severin. Report of Committee on Mercury's report. Report of Nominating Committee.

1 P. M.

Automobiles will be supplied for all registered Jovians and registered wives of Jovians, leaving Hotel Severin promptly at 1 p. m. for 100-mile race at the famous Indianapolis speedway in which will participate some of the world's best drivers.

1:30 P. M.

Concert at the speedway by Robbins & Myers Company's band.

2 P. M.

Start of the 100-mile race at the Indianapolis speedway.

3:30 to 4 P. M.

Automobiles will leave the speedway with registered Jovians and wives, driving to the picturesque Indianapolis Athletic and Canoe Club where a buffet luncheon will be served and an hour or two pleasantly spent in the clubhouse and grounds.

8 P. M.

Annual Rejuvenation. Murat Theater, New Jersey and Massachusetts Avenues. Introductory address by Fourteenth Jupiter Thomas A. Wynne. Entertainment by Stentors. The rejuvenation by the Indianapolis degree team.

Friday, October 20.

9 A. M.

Business session, Assembly Room, Hotel Severin.

10 A. M.

Address by Robley S. Stearnes, New Orleans, president, National Electrical Contractors' Association, on "Jovianism from the Contractor's Viewpoint." Address by James M. Wakeman, New York City, general manager, The Society for Electrical Development, "Co-operation with the Society for Electrical Development." Address by Harry W. Alexander, New York City, director of publicity, The Society for Electrical Development. Subject: "America's Electrical Week."

11 A. M.

Address by Katherine M. H. Blackford, M. D., New York City, the Review of Reviews Company, on "Character Analysis by the Observation Method." Dr. Blackford has made a life study of this subject and is acknowledged to be its foremost exponent.

12 M.

Election by ballot of Fifteenth Administration Congressmen and Statesmen.

Adjournment to 8 p. m.

1 P. M.

Luncheon tendered registered Jovians by Indianapolis Chamber of Commerce.

3 P. M.

Degree-team competition.

8 P. M.

Installation of the newly elected fifteenth administration officers. Announcement of winners in degree-team contest. Automobile drawing.

Closing Entertainment: "A Night in Bohemia." The Entertainment Committee has concentrated all its resources upon the closing entertainment and promises that it will be replete with surprises and features that class it greater than any similar affair ever undertaken. Buffet supper.

State-Wide Electric Range Campaign Proposed By Indiana Electric Light Association.

An innovation in new-business campaigns has been proposed for the state of Indiana. If carried out as now proposed, it will be a special range campaign, beginning with general publicity on the practicability and advantages of electric cooking carried on for several months during the coming winter and culminating in a strong and concerted state-wide sales effort during next May. This project was suggested to the Indiana Electric Light Association on the second day of its eighth annual convention on September 13 at Fort Wayne, Ind. The suggestion came from R. A. MacGregor, of the Merchants' Heat & Light Company, Indianapolis, following the presentation of his paper on "Why the Electric Range Has Come to Stay," which is abstracted at some length on other pages of this issue. Mr. MacGregor's plan is to make it a co-operative effort under the auspices of the state association backed by the aid of manufacturers and jobbers of electric ranges.

The proposal was well received, among those discussing it being Messrs. Hart Boohrer, Poor, Robb, Palmer, Donahue and Condon. The discussion brought out that the time for preparation was too short to hold the campaign next December in connection with America's Electrical Week; moreover, the logical time for an effective electric cooking campaign is in the spring, say May, just before the approach of hot weather. It was decided to refer the matter to the New Business Committee, which at an early meeting will consider the general scope and principal details of the campaign and sound the sentiment of the member companies regarding it.

As stated in our last issue in reporting the first part of the convention, the proceedings covered a very wide range of topics interesting to electric utilities. A paper by M. D. Cooper, National Lamp Works, Cleveland, O., on "Voltage Standardization," was read by C. E. Egeler. It was a strong plea for the adoption of three standard voltages, 110, 115 and 120 volts, instead of the multiplicity of potentials now in use. Among the advantages of greatest moment is a probable reduction in cost of manufacture of lamps. This matter was referred to the Committee on Standardization. President Condon read the report of the Insurance Committee, which earnestly recommended the plan of reciprocal or inter-insurance and particularly indorsed the Utilities Indemnity Exchange as a medium through which upwards of 25 per cent could be saved on liability insurance.

George B. Muldaur, special field representative of the National Electric Light Association, made an explanatory address touching on the advantages to the Indiana Electric Light Association of affiliating itself with the National Association as a geographic section. There are now ten such sections which enjoy the peculiar special privilege of direct co-ordination of effort, immediate availability of the immense store of valuable data collected at the national headquarters, regular supply of the numerous association publications, etc. The details of affiliation were explained. After some discussion, the trend of which seemed to be favorable to the proposal, the matter was referred to the Executive Committee for further consideration and power to act.

At the final convention session held on Thursday morning, G. L. Lindsley, of the Lindsley Brothers Company, read an illustrated paper on "Poles and Pole-Line Construction," which will be published practically in full in an early issue. A paper was then read by C. B. Hart, of the Fort Wayne & Northern Indiana Traction Company, entitled "The Spark Plug of the Electrical Industry." This paper made an earnest plea for hearty co-operation between the different departments of a central-station organization and showed particularly how the lasting success of efforts made by the new-business department depends to a large degree on the help given by the other departments. The entire central-station organization was compared to the make-up of an automobile, in which the spark plug corresponded to the sales or new-business department. This paper was briefly discussed by T. Donohue, E. J. Condon and C. C. Perry.

W. H. Patterson, of the Westinghouse Electric Manufacturing Company, read a paper on "Development of Central-Station Power Load." This showed the need of an efficient power-sales organization and of systematized power surveys. The data to be gathered and the character of reports to be made were discussed. With comprehensive data available it is possible to concentrate on the most desirable and easily obtained prospects. The great possibilities of central-station power development in Indiana were pointed out.

E. J. Condon, Jr., of Angola, read a paper on "Inductive Interference and State Regulation of Pole Lines." Attention was called to the conflict of opinion on this subject by different utility interests and the unreasonable stand taken particularly by telephone companies. It was pointed out that the solution of the interference problem should be co-operative, else the burden will be prohibitive for any single utility. The important bearing of the National Electrical Safety Code on this general problem was also shown. The paper was discussed by Judge Barrett, of Fort Wayne.

The final paper was presented by W. J. Canada, of the Bureau of Standards, Washington, D. C. It dealt entirely with the National Electrical Safety Code, pointing out how the absence of electrical safety regulations and the conflicting character of those in vogue has been responsible for numerous serious accidents, many of them fatal. Efforts made to include safety rules in the present National Electrical Code or in a separate code to be drafted by liability-insurance interests met with failure, consequently the Bureau of Standards was urged to study the general subject of electrical life hazards and to draft a set of standards that would be national in their general applicability and effective in reducing the hazards of electrical construction and operation to a minimum. This the Bureau was authorized to undertake. A large number of conferences were held in different parts of the country and many investigations and field tests were made to determine reasonable safety requirements. The drafting of the National Electrical Safety Code has taken several years. Its completed form for general distribution and experimental application is now in the hands of the printers. Mr. Canada explained the general character of its four principal sections and urged that an earnest effort be made to try out its provisions for a year. He also suggested that state and local legislation dealing with electrical safety might be deferred until the results of the elaborate and costly investigation of the subject, which are incorporated in the new code, are available as a basis for such legislation.

The Nominating Committee then presented its recommendations for officers of the association for the ensuing year, which were unanimously elected as follows:

President, Samuel W. Greenland, general manager of the Fort Wayne & Northern Indiana Traction Company, Fort Wayne.

Vice-president, J. P. Ohmer, of Elkhart.

Secretary-treasurer, Thomas Donohue, La Fayette.

Executive Committee, E. J. Condon, Angola; T. F. Grover, Terre Haute; A. C. Blinn, Evansville; C. C. Perry, Indianapolis; T. F. English, Muncie.

Advisory Committee, J. W. Robb, Clinton; F. A. Bryan, South Bend; P. H. Palmer, Kokomo.

Co-ordinating University and Shop Work

An Outline of the System of the University of Cincinnati in Co-ordinating the Work of the Technical School with Manufacturing Industries and Central Stations

By A. M. Wilson
Professor of Electrical Engineering, University of Cincinnati

THE purpose of the co-operative principle in education is to bring education and practical experience or industry together as closely as possible. Judging from the expressions of those most deeply interested, the ordinary technical courses cannot reproduce the shop atmosphere. And if the work of the technical schools can be done economically and satisfactorily by the operating and manufacturing companies, the question of the continued existence of technical schools would be quite reasonable and proper. But, judging from the growth of technical schools, this question is not likely to arise. Looking at the situation from what seems to be a sane, conservative standpoint, it seems as though the technical schools should perform the function for which they are best fitted, and the shops and operating companies should perform that part of the educational function for which they are best fitted. These latter have to perform this function anyway, according to their own statements, with which practically every one agrees. The co-operative principle merely proposes that both of these functions be planned and co-ordinated as intelligently as possible.

This co-operative principle was first enunciated clearly and in workable form by Herman Schneider, now dean of the College of Engineering of the University of Cincinnati. After trying for some time to interest various firms and institutions in this proposition, in 1906 he succeeded in applying it to courses in mechanical and electrical engineering at the University of Cincinnati, in connection with several manufacturing plants. These manufacturing plants furnished jobs for the students. There are two students for each job. While one is attending the university, the other is engaged in practical work. At first the men changed places every week; but for several years two weeks has been the normal period. At the present time there are more than eighty firms or corporations in and about Cincinnati co-operating with the university. During the ten years that have elapsed since the beginning of this work, all sorts of business conditions have been experienced, and it may be of interest to note that the attendance has increased steadily even during the rather prolonged periods of business depression and disturbance.

The foregoing is a rather sketchy outline of the situation. Much has been written about co-operative education during the past ten years. But it is possible that some who may read what follows have not had time or opportunity to follow such matters closely.

In the beginning the attendance was small. The students of electrical engineering did their practical work in connection with a few plants engaged in the manufacture of electrical machinery. But about five years ago, one young man employed in the meter department of the Union Gas & Electric Company decided to obtain a technical education. He was under the impression that if he entered the co-operative course, he would have to give up his job, so he gave it up without discussing the matter with F. R. Healey, the superintendent in charge of that department. Some time later Mr. Healey ran across the young man, and on learning why he had left, explained that the company did not discriminate against any employee who showed proper energy and initiative, and that it was not necessary for him to leave the company in order to carry out any reasonable plans for increasing his efficiency. On this basis the young man went back to work for the company. Two years later, or three years ago, another young man in the same department started in the co-operative course. Two years ago the Union Gas & Electric Company tried out a number of students in various departments, and met with sufficient success to justify adding more students last year and this year. At present there are nearly twenty co-operative students employed in the various departments of the company.

In the power plant the co-operative students have usually been started on the water-treating apparatus. Then they change to oiling, firing, stock-keeping and such other work as their personal characteristics seem to justify.

Those who go to the meter department begin as helpers for meter readers. Then they are put at repairing and testing meters, meter reading, and later are assigned to such work as they are best fitted for, such as handling special cases of trouble, special testing, etc. It was at first expected that some of these men would prove valuable in connection with the new-business department, but our data so far do not check these expectations. Sufficient time has not elapsed to justify any definite conclusions in regard to this tendency.

WORK RECORD CARD

NAME W. K. Lehrer CLASS OF 1918 SCHOOL YEAR ENDING AUGUST 1916 SEMESTER 2.
FIRM "

WEEK ENDING	HOURS WORKED	HOURS LOST	DEPT	NATURE OF WORK DONE
Feb 26	73½		Power	Stockkeeper.
Mar. 4	73½		"	"
Mar. 25	73½		"	"
Apr. 1.	73½		"	"
" 11	73½		"	"
" 1	66½		"	"
May 6	66½		"	"
" 13	66½		"	"
TOTAL	567			

DEGREE E.E. ENTERED SEPT. 1915 WAGES Feb 1916 RATE 20
RAISED Apr. 191_ RATE 24

Co-operative Student with Union Gas & Electric Company as Storekeeper, and Copy of Work Record Card.

A little over a year ago, a few students were assigned to electrical repair work and substation operation. It developed that these men were not satisfactory in their school work, and as they had not achieved any marked success with the company, they were withdrawn. It was agreed that there is no reason why co-operative students cannot give complete success in this work, when the proper combination is secured. Incidentally, the men referred to have since been quite successful in other work.

A serious attempt was made, a year ago, to use some co-operative students in connection with the electric shop. This department's function is probably indicated clearly by its name. These "co-ops" were to solicit business under the direction of Mr. Flower, who has charge of the shop. A number of students in the electrical department, who appeared to be fitted for such work, were interviewed, with a view to interesting them in it. Only a few decided to try it. Only one of these proved satisfactory on the job. And it may be of interest to note that not one of those picked as possible salesmen was satisfactory as a student. The data available are not conclusive, but it is quite apparent that public-utility sales work of this character is not the easiest work that can be chosen. It is also apparent that our students who give promise of being successful engineers do not appreciate the opportunities in this field. It would probably have been better if we had not used first-year students in this work, although there were several reasons why older students could not be used. Possibly conditions will be such in the future that another attempt can be made along this line.

Three years ago the Dayton Power & Light Company took on a number of "co-ops." Several of these students live in Dayton, so that they are at home during their work periods. While these students made a satisfactory record during the school year of 1913-14, no additional students were added during the summer of 1914, due to the abnormal conditions immediately following the outbreak of the war. Last summer a few upper-classmen who happened to be available, and who were anxious to get into public-utility work, were added. And this summer a number of new men have already begun work with the company, with a view to entering the university this fall. By that time the total number of university co-operative students employed by the company will be about twelve. One of the upper-classmen who did co-operative work last year was graduated in June, and is now a full-time employee of the company.

On account of the very rapid increase in connected load, and the difference in organization and local conditions, the work of the co-operative students with the Dayton Power & Light Company has been slightly different from that of the students with the Union Gas & Electric Company. But the same range of experience is obtained. Conditions are changing so rapidly that it is not possible for a young man of energy and initiative to be sidetracked. Some are employed in the meter department, some in the power plant, and some in new construction, installation and repairs. The students are put at work for which they are best fitted, and have abundant opportunity to get practical experience of great value. Inexperienced freshmen start at 16 cents an hour. If their work is satisfactory they are given an increase of two cents an hour every six months until they receive 26 cents an hour. After that each man gets what he is worth to the company. The minimum rate in Cincinnati is 15 cents an hour. The extra one cent an hour in Dayton more than makes up for the necessary railroad fare. While the pay at starting may seem low to some, the training and supervision the student receives has some value, and by the end of the third year the student is in a position to demonstrate his value. Those who have gone through practically the same sort of development in other lines have realized at the end that it has been a good business proposition for them. And the basic argument in interesting co-operative firms in the course is that it must be a fair business proposition to all concerned.

It must be realized that in educational processes the time element is an important factor. The data available in two or three years are not sufficient upon which to base broad conclusions. But it may be of some interest and value to state the experience up to the present. It has never been our policy, in describing the working of the co-operative principle, to use what might be called an imaginary viewpoint, and to glorify the facts as much as the occasion may seem to require. This viewpoint has been used to such an extent in other educational fields that doubtless some who have not had the opportunity to observe the practical operation of the co-operative principle may discount some of the statements concerning it.

For instance, problems in vocational guidance are continually arising in connection with the co-operative work. The experience in connection with the electric shop of the Union Gas & Electric Company may serve as an example. It is our experience that no information secured in a brief, preliminary interview, can be used as a safe guide in determining the line of work in which a young man will be most successful. In deciding upon changes of work for the students, the opinions of superintendents and foremen, based upon very definite results, are usually the most important factors.

The Dayton Power & Light Company, in looking for desirable material for use in connection with the co-operative course, took up the matter with the high schools located along its lines. In this way it was hoped to interest a number of high-

WORK RECORD CARD

NAME H. R. Burns | CLASS OF 19 19 | SCHOOL YEAR ENDING AUGUST 1915 | SEMESTER 2.

FIRM Union Gas and Electric Co.

WEEK ENDING	HOURS WORKED	HOURS LOST	DEP'T	NATURE OF WORK DONE
Jan 30	70		Power House	Operating Filter.
Feb 6	70		"	" " and Firing.
Feb 27	70		"	" "
Mar. 6	70		"	" "
Mar. 27	70		"	" " and pipe fitting
Apr. 3	70		"	" "
Apr. 24	70		"	" "
May 1.	70		"	" "
TOTAL	560	0		

DEGREE E.E. ENTERED SEPT. 1914 WAGES June 1914 RATE 17½¢ RAISED 191 RATE

Co-operative Student Testing Water at Union Gas & Electric Plant, and Copy of Work Rec ord Card.

school graduates from the communities with which the company does business. This application of the co-operative spirit, if pursued as a settled policy for a number of years, will doubtless prove to be a good thing for all connected with it.

The co-operative students with both of these companies are deeply interested in the work of the N. E. L. A. Company Sections, and have no difficulty in giving the same degree of loyalty to the company that they give to the university. This does not mean that every student is always entirely satisfied with his job, any more than he is always satisfied with his grades and his standing at the university. But in the everyday give-and-take intermingling of university life and practical experience, the former loses a good deal of its atmosphere of irresponsibility, and the latter acquires some of the college loyalty.

Each student is visited from time to time while at work, and records of his work are kept by the university. Some cards are shown, such as are filled out by the students from time to time. During the second year, in the department of electrical engineering, one class meets twice a week, in which each student has several opportunities to tell the others about what he has been doing, together with what he may have seen or read in connection with his job. For instance, students employed on the water-treating apparatus at the power plant of the Union Gas & Electric Company have been required to explain the entire layout of piping and the chemical reactions involved in softening and filtering the feed water. Those employed in the meter department are required to give detailed accounts of what goes wrong with the meters they come in contact with, and practical points in connection with their repairs.

There is no inherent difficulty in co-operating with the Dayton Power & Light Company. It takes less than three hours to go from Cincinnati to Dayton. So far as the distance is concerned, it is comparatively easy to operate within a radius of a day's travel. If the periods of university and shop work were made longer, the radius of operation could easily be made even greater.

The chief inherent difficulties in the operation of the co-operative courses are those introduced by the students. Readers who have responsible charge of men will appreciate the fact that in dealing with human material, there is a very appreciable percentage of it defective. They will also appreciate the fact that the defective material always gives the most trouble. The co-operative courses have no superhumanity to deal with. And it is sometimes difficult to get prospective students to realize that they cannot get more out of our co-operative courses than they put into them. But those who do put the necessary effort and loyalty into the work seem to find that they have been well repaid.

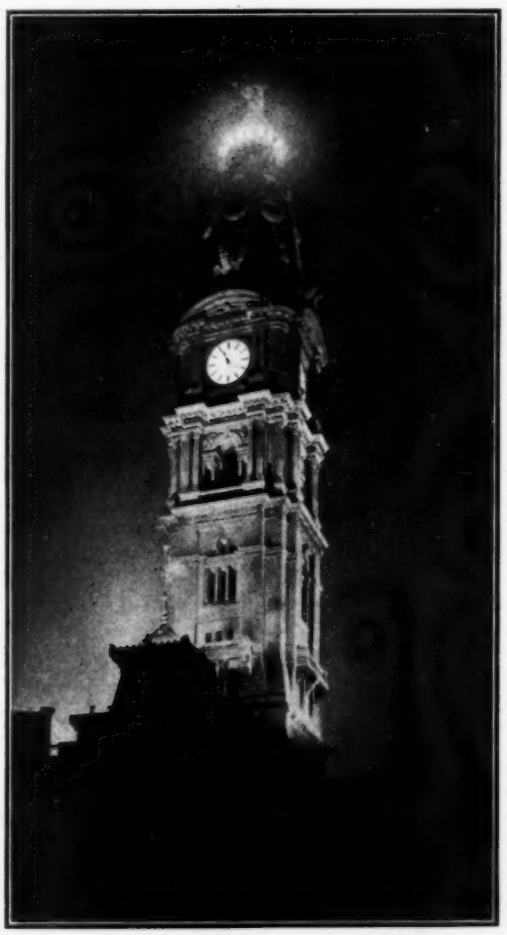
Flood Lighting of Philadelphia's City Hall Tower.

One of the numerous special points of interest for visitors to Philadelphia is its stately City Hall, with its magnificent tower rising to a height of 547 feet above the ground and surmounted with a large statue of William Penn, founder of the city. By day this tower can be seen from nearly all parts of the city and forms one of its chief landmarks. For some time it had been proposed to illuminate the tower so that it could be as readily seen by night also. A few months ago the lighting equipment was installed and the brilliant flood lighting of the tower has since been the marvel of visitors and citizens alike, attracting special interest during this week's convention of the Illuminating Engineering Society.

This grand illuminating effect was conceived and boldly executed by James F. McLaughlin, chief of the City Electrical Bureau, who was ably assisted by Harry Holz and William C. Rommel, of his department, in carrying out the innumerable details necessary to make this one of the largest and most successful permanent installations of flood lighting in existence.

To illuminate this tower and statue, 288 flood projectors, each equipped with a 500-watt flood-lighting gas-filled Mazda tungsten lamp, were used. The projectors are G. E. type, form L-1. This is an unusually large number for the area lighted, but the reasons therefore were dual.

In the first place, it was desired to light the tower to such an intensity that it would be visible from all parts of the city and surrounding suburbs. A considerably lower intensity would make the tower effective at close range, but to show it up at a distance higher intensity was necessary. Secondly, the upper third of the tower and the the statue are of bronze. This metal is well weathered, being a handsome dark brown, almost black in places and a corroded green in others; it is, therefore, an exceedingly poor reflector of light. It was determined, after careful study and demonstration tests, that about five watts per



Flood Lighting of Philadelphia City Hall Tower.

square foot would be necessary to make this part of the tower stand out well at night. The lower part of the tower is of gray granite, and one watt per square foot was found sufficient energy consumption for this portion.

It may be of interest to know the method of distribution used. The flood-lighting projectors are located in eight groups. A total of 128 projectors, arranged in groups of 16 at each station, are trained on the stone part of the tower. An additional 128 projectors are trained on the bronze part of the tower. These, too, are in groups of 16. There are 32 projectors trained on the statue and its pedestal from four stations of eight projectors each.

Present Status of the Electrical Industry

Orders for Electrical Apparatus Booked by General Electric and Westinghouse Companies Are Indicative of the Prosperity of the Industry, Although Heads of These Organizations State Production Conditions Are Unsatisfactory

THE vast volume of business now being handled by the Westinghouse Electric & Manufacturing Company and the General Electric Company has never been paralleled in the history of these manufacturers. The two companies are taking orders this year at the rate of $225,000,000 per annum, which is $90,000,000 or 65 per cent in excess of any other year in their corporate existence. According to a statement in the *Wall Street Journal* the Westinghouse company will manufacture during the fiscal year to March 31, 1917, including its shell orders and other munition orders, aside from rifles, between $90,000,000 and $100,000,000 of finished products.

Those who have studied into the condition of the electrical industry in the United States during recent weeks have been amazed at the sold-up condition of great concerns like Westinghouse and General Electric. It is understood that in the turbine departments of both these big producers no deliveries of turbines short of 18 months are being promised. In fact, some very large contracts have been taken this week, calling for 18 months' delivery. In other lines Westinghouse is sold ahead at capacity for seven and eight months, and the same statement is true of General Electric. These two companies have orders in hand for 20,000 to 25,000 motors alone.

Because of the immense pressure which incoming orders are exerting, Westinghouse Electric has purchased 500 acres of land on the Delaware River, and will use it as the nucleus of a new manufacturing center. The physical possibilies in its East Pittsburgh location are so clearly exhausted that it was imperative that a new center be started if the company is to continue to hold its normal proportion of the industry.

Indicative of the prosperity of the manufacturers of electrical equipment and the entire electrical industry, but teeming with the difficulties encountered by manufacturers, were addresses made by G. E. Tripp, chairman of the board of directors of the Westinghouse Electric & Manufacturing Company, and E. W. Rice, Jr., president of the General Electric Company, before the Association of Edison Illuminating Companies, at its thirty-seventh convention at Hot Springs, Va., September 5-7. The excerpts from these addresses serve admirably to show the conditions now existing in the manufacturing branch of the industry.

Abstract of Mr. Tripp's Address.

In order to get a comprehensive view of present manufacing conditions in the electrical industry, it is necessary to review for a moment a little of its past history. When the electrical industry began it was something more than the mere selling of a manufactured product. It was the application of scientific knowledge to practical uses and required close co-operation between the manufacturer and the pioneers in the public utility field.

The tremendous importance of individual genius was the predominating feature of this period, and manufacturing was largely confined to the development of the particular apparatus which some farseeing man had invented or developed. As a natural consequence, the same man became an indispensable factor in the application of his conceptions to the public use; and from this condition arose, not electrical manufacturers, as they are now constituted, but organizations standing sponsor for and producing goods according to systems developed by the great chiefs of the electrical science. Through these agencies there sprang up a great number of small insallations of street railways and electric light companies, serving the routine local wants of the ordinary citizen in his daily life. This was the first step in the evolution of the industry.

Perhaps the next stage may be described as that in which the various systems were sifted out, not however by the predominance of one or the other, but as is used in such circumstances by a combination of the best points of all of them, until the manufacture of electrical apparatus and the application of it became more or less standardized. That is to say, while invention and research went on, and is still going on, and important improvements were from time to time made, and are being made, it is a fact that the large manufacturer of electrical apparatus can and does produce machinery and apparatus that is adapted to any kind of electrical service.

When the manufacture of electric apparatus had reached this stage it made possible the new era of central-station development, which resulted in a great expansion of the uses of electricity, the history of which has been a matter of comparatively few years. The isolated electric light plant which had no power business and gave a local individual service which had no great fluctuations, has passed away and has been replaced by huge central-station organizations which sell a great percentage of their output for uses in all lines of industrial activity, and whose business will more and more tend to rise or fall with the general tide of industry.

The demand for large generating units has been greatly increased, due to the more intelligent and energetic conduct of the electrical business under concentrated control, for it is an undoubted fact that scientific management keeps pace with conentration. I believe that the tendency for combination and consolidation of public utilities is bound to go on from a purely economic standpoint, and that this irresistible tendency will present many political problems for solution, but I have referred to them solely for the purpose of enabling you to better understand that the demands from the manufacturer, brought about by the sudden and tremendous impetus given to almost every branch of industry in the United States on account of the European War, was the combined result of these great aggregations and the large use made of them by industrial enterprises. That is to say, manufacturing industries of all kinds, which have been recently taught to use electricity as a power, called for an increase in service, the magnitude of which was as unforeseen as it was abrupt.

The experience of our company will serve to illustrate how sudden and unexpected was the demand made on the manufacturing industries of this country during the latter part of 1915. The war began August 1, 1914. At that time we had unfilled orders on our books of about $8,000,000. This was a small amount, and represents about two months theoretical full output of our shops. The outlook was anything but encouraging. On Februray 28, 1915, which was the lowest point we reached, we had on our books approximately $5,600,000 of unfilled orders, a falling off of 30 per cent. Our shops were running at not over 50-per-cent capacity, and the total number of men on our payroll was about 14,800.

While February, 1913, was the low period, there was not great improvement for several months afterward. In fact, the real upward movement did not begin until November 1, 1915, at which date we had on our books $8,900,000 of unfilled orders. In order that you may have these figures more

clearly in mind, let me recapitulate. On August 1, 1914, at the beginning of the war, we had on hand $7,900,000 orders. On February 28, 1915, which was our low period, we had on hand $5,580,000. On October 31, 1915, or 14 months after the beginning of the war, which marked the real beginning of the avalanche, we had on hand $8,900,000. From that time on there was no cessation of increases. Notwithstanding we increased our forces from the figure of 14,800 to nearly 30,000, and ran our factories to the fullest possible capacity, we have on hand today unfilled orders for electrical goods amounting to considerably over $30,000,000.

In all these figures I have given I have taken no account whatever of orders for war munitions. I am referring to our regular product, in which, as you have seen, notwithstanding the very large output of our shops during the last eight months, our unfilled orders have inceased over the low point of February, 1915, by almost 600 per cent.

I have no figures at hand giving statistics as to the demand for labor upon the munition industry, but I should hazard a guess that 150,000 or 200,000 new jobs would not be excessive; and, as the number of men we have employed on munition work amounts to about 4,500 in Pittsburgh, it is fair to say that our labor conditions would have been just as serious had we never taken a war order. Our greatest task is to find a sufficient supply of the two extremes, viz., the highly skilled and the common laborer. The first is practically unobtainable, and the latter is becoming scarcer, more expensive, and less efficient. It is not difficult to hire enough men, but they will not stay.

Up to this point I have endeavored to outline some of the conditions under which we are now working, but I should like to add something from the financial and profit side, and to say at the outset that, under normal conditions now and in the future, so far as I can foresee, an electrical manufacturer will not be able to earn any more than a fair return upon the actual cash invested in the business; that is to say, no cash returns are to be expected upon patent rights, good will and other intangibles of that nature. It may be possible for a concern to do it for a few years, but it will be because an insufficient amount is being expended in research and development work, and that policy carried on long enough will eventually put any electric manufacturer out of business. We expended last year in research and development over $1,000,000, and that amount, of course, comes bodily out of net earnings, because it is an expenditure that cannot bear immediate fruit, and it would only be warranted on the expectation that the general law of averages over a period of years, would, in a thousand ways add that and more to the money value of the company's business.

The profits in the business are undoubtedly close. I think our shops are operated with reasonable efficiency, and I think our sales department gets as high a price for the product as possible, but until last year, which included war profits, there has never been a year in the last ten years that the Westinghouse Electric & Manufacturing Company made as high as 15 per cent on the selling price of its output. The figures have ranged from eight per cent minimum to 14 per cent, with an average of say 12.5 per cent.

This is a close operation, and requires that, for safety, a manufacturing company should turn its capital over once a year, and where it has not yet reached that desirable stage it is undoubtedly wise policy to constantly increase its reserves until the goal has been attained, and the Westinghouse company has pursued and will pursue that general policy so far as it is able to do it.

Abstract of Mr. Rice's Address.

The situation in regard to general manufacturing conditions is, from a production standpoint, extremely unsatisfactory. Stocks in the hands of manufacturers and dealers in metals and machinery, which were allowed to become depleted, owing to the abnormal reduction in business, were quickly exhausted upon its revival. All manufacturers and dealers in such materials and appliances soon became overwhelmed with orders, and consequently there has been for the past year, and still continues to be, the greatest difficulty in obtaining raw materials and equipment, particularly those of a special nature. The demand for copper and brass materials, iron and steel, sheet steel, castings, forgings, etc., has for some time greatly exceeded the capacity of the producing concerns in this country. Promises made by producers of raw materials and machinery and tools, of every description, have been found, by sad experience, to be extremely unreliable, and this naturally interferes with our schedules of manufacture of finished goods. There is little, if any evidence, of a change in the situation in the immediate future, and we anticipate that difficulties will continue to be experienced in obtaining raw materials. As a result of oversold conditions prices have been advanced tc unprecedented figures.

The increase in prices of raw materials and machinery has not been permitted to directly affect production unfavorably, as these prices have been met. The fundamental difficulty which has constantly interfered with production schedules has been the inability to get machinery and materials, either on time or in sufficient quantities to keep our factories operating in an efficient manner. In some instances materials and machinery which heretofore have been employed have been unobtainable, and new materials, machinery and methods have been substituted, all of which has involved delay in production. Even after we had succeeded in purhasing our raw materials, and shipment had actually taken place at the point of manufacture, there was no assurance that the material would arrive on time. The railroads, as is well known, became so congested that deliveries were slow and uncertain, and complete embargoes were frequently placed upon the delivery of important materials, and, always, it would seem, at the most unfortunate time for ourselves and our customers.

The manufacturer, however, needs something more than buildings, machinery and raw materials in order to fill the orders of his customers. He must have labor of good quality and of reasonable and reliable supply, and, manifestly, it is impossible to cope with the increased volume of business without an increase in the efficiency of labor, or an increase in quantity. In spite of all our efforts the labor situation for the last year has been, and still remains in a very unsatisfactory condition, especially with reference to high grade skilled employees and low grade common laborers. There does not seem to be a sufficiency of either class to meet the demands of production in this country. As is well known, the scale of wages of such employees is abnormally high, which condition has been intensified by competition among the manufacturers themselves.

The increase in the price of labor would not in itself affect production adversely; it might, in fact, under proper conditions, lead to a stimulation and improvement of production. However, unfortunately, there is every evidence that the efficiency has, temporarily at least, declined, and the output per man is lower than it has been heretofore at a time when it is to the interest of all men engaged in the industry, as well as the employers, to obtain the highest possible output.

The large contracts which have been taken for war munitions have unquestionably affected the general manufacturing situation. They have created a demand for enormous quantities of brass, copper and steel, and are largely responsible for the condition in which the producers of such materials find themselves, viz., almost complete inability to fill orders.

As to what extent, if any, the manufacture of munitions by our company has interfered or may interfere with deliveries of our regular product, I frankly admit at once that such contacts as we have taken for munition have, and will,

until completed, interfere to a relatively limited extent with our regular business. I may further confess that if we had anticipated the prompt revival of business, to say nothing of the phenomenal increases in our regular business, we would never have undertaken the manufacture of any munitions.

At this time it is difficult to express a definite opinion as to the deliveries on 1917 contracts. We have taken large contracts for delivery in 1917, and in some cases even for 1918. We are contracting for important materials as far in advance as seems to be necessary, in order to insure deliveries. In order to be assured of a supply it seems to be necessary to place orders for some materials well into 1917. In such cases we have not hesitated to take the risk.

The great increase in the cost of raw materials and labor, as well as other items of expense, have made it necessary for us to increase our prices. We have not, however, advanced our prices more than necessary to cover increased cost of manufacture. In some classes of apparatus, through the skill of our engineers in redesigning, without sacrifice of quality, we have effected economies offsetting, in part, at least, the normal increase cost, and in such instances our prices have not been increased to the extent that otherwise would have been necessary.

As to future prices, we are so completely dependent upon the prices which we must pay for raw materials and labor that it is impossible for us to express an opinion which would be of special value. It would almost seem that the high water mark, with respect to prices of raw materials and labor, has been reached, and, if so, with a continuance of such conditions, future prices of our materials would naturally remain substantially unchanged. Of course upon any extended reaction in business, which some authorities assure us will take place, upon the cessation of hostilities, prices would naturally decline.

It has been suggested that the large profits on munition contracts have established a precedent which may have a bearing upon the electrical business. I do not share in this view, as the electrical business is highly competitive, and in normal times the volume of demand is less than the combined facilities of all the manufacturers.

Massachusetts Utilities Make Large Gain Over 1914-15

Boston Edison Company Shows 12.5 Per Cent Increase in Output

Returns of the electric light companies operating in Massachusetts, recently filed with the State Board of Gas and Electric Light Commissioners, show important increases in output and sales in all departments for the year which ended June 30, with scarcely an exception. The more conspicuous gains were in the larger industrial centers, where the phenomenal increases in power consumption make a formidable showing. Of the eight larger companies, aside from the Boston Edison, a clear gain, both in total output and an energy, sold for street lighting, commercial lighting and for power, is recorded. The Lowell Electric Light Corporation generated nearly 50 per cent more energy than in the year 1914-1915, while its power load more than doubled. The New Bedford Gas & Edison Light Company increased its output from eight and one-third million units to nearly 15 million, and its power load increased more than 50 per cent. The Worcester Electric Light Company is another central station showing a large power growth, in this case amounting to nearly 50 per cent.

The most notable growth in output and in power load is in the case of the Salem Electric Lighting Company. Kilowatt-hours generated were more than twice the output of the year preceding, while the company's power load grew from about two and a half million to nearly 10 million units, or almost 400 per cent.

The output for commercial lighting, in all eight companies, shows a healthy gain, despite the increasing use of tungsten and nitrogen-filled lamps in place of those of less efficiency.

Gains of Boston Edison Company.

An increase over the preceding year of about 12.5 per cent in the number of kilowatt-hours generated, and of 12 per cent in net income from the sale of electricity, for the year which ended June 30, 1916, is shown in the annual return of the Edison Electric Illuminating Company of Boston, filed September 13, with the Massachusetts Gas and Electric Light Commissioners, in accordance with the statute.

The total amount of energy generated the past year is 223,258,020 kilowatt-hours, as compared with 198,390,000 kilowatt-hours the preceding year. The total net income from sales is $8,302,814, compared with $7,429,124 in 1914-1915.

The maximum station load during the past year fell on December 13, 1915, when it was 72,802 kilowatts. The maximum load on day of least output was 22,300, this being on Sunday, July 11.

Comparative figures of income for the two years follow; cents omitted:

	1916	1915
From Commercial lighting	$5,653,226	$4,947,922
From Public street arcs	488,808	561,085
From Public street incandescents	377,463	306,106
From Electric power, except street railways	1,482,707	1,339,321
From Electric power for street railways	197.361	184,844
Total	$8,199,566	$7,339,279

Expenses compare as follows:

For manufacture:

	1916	1915
Coal, at works	$ 751,667	$ 712,734
Rental of real estate	42,935	36,056
Oil, waste and packing	3,558	3,208
Water	21,173	19,345
Station wages	344,852	318,757
Station expenses and tools	2,457	1,325
Station structure repairs	14,573	19,121
Steam plant repairs	114,375	101,144
Electric plant repairs	124,533	119,804
	$1,420,123	$1,331,494
For distribution	932,996	926,498
Office expenses and management	904,733	853,967
Taxes, Munic., Corp'n, State and U. S.	954,760	843,450
Miscellaneous expenses	406,497	376,859
Total expenses	$4,619,184	$4,332,346
Balance to profit and loss	3,683,630	3,096,778
Ratio of operating expenses to gross earnings	55.6%	58.3%

Coal burned during the past year amounted to 198,951 tons, costing an average of $3.78. In the year preceding, 182,679 tons were burned, costing $3.90 per ton.

COMPARATIVE OUTPUT AND DIVISION OF SALES, EIGHT MASSACHUSETTS COMPANIES.

COMPANY	Kwh. Gen. 1916	Kwh. Gen. 1915	Sold for Street Lights, 1916	Sold for Street Lights, 1915	Sold for Com'l Ltg., 1916	Sold for Com'l Ltg., 1915	Sold for Power, 1916	Sold for Power, 1915
Cambridge El. Lt.	17,105,000	15,213,000	1,159,000	1,278,000	2,991,000	2,886,000	9,462,000	7,745,000
Fall River El. Lt.	16,987,000	14,008,000	1,881,000	1,777,000	2,757,000	2,482,000	9,340,000	7,023,000
Lowell El. Lt. Corpn.	19,448,000	13,097,000	2,099,000	1,884,000	3,105,000	2,743,000	9,245,000	4,490,000
Lynn Gas & El.	14,053,000	12,756,000	1,556,000	1,533,000	4,644,000	4,115,000	4,615,000	4,275,000
New Bedford Gas & Edison Lt.	14,949,000	8,356,000	1,466,000	1,430,000	2,843,000	2,677,000	3,375,000	2,150,000
Salem El. Ltg.	13,676,000	6,675,000	717,000	693,000	1,636,000	1,300,000	9,959,000	2,650,000
United, Springfield	34,129,000	31,106,000	4,499,000	4,019,000	7,791,000	6,839,000	11,995,000	8,950,000
Worcester El. Lt.	*40,751,000	33,399,000	3,303,000	3,179,000	7,743,000	6,372,000	22,823,000	15,406,000

*Of this 8,015,000 kwhrs. were bought of Conn. River Transmission Co.

COMMERCIAL PRACTICE

New-Business Methods, Policies, Rates and Kindred Central-Station Matters for the Man Engaged in Selling Electricity

New Lighting Rate for Westerly, R. I.

The Narragansett Electric Lighting Company, Providence, R. I., has filed with the Public Utilities Commission a rate of 12 cents per kilowatt-hour for house lighting in Westerly, R. I., effective as of September 1. The rate has been 14 cents.

A minimum monthly charge of $1 is a part of the schedule. This was objected to, at a public hearing, by a number of citizens who are in the habit of closing their homes during the summer months. It was urged that the usual Massachusetts practice of allowing an overplus to offset the shortage in months when consumption is slight be adopted locally.

A representative of the Narragansett company, however, pointed out that the minimum is to provide against financial loss from one class of customers, saying that in every meter installed there is an average daily loss of about six watts and in each transformer a loss of one to two per cent, according to rating. He pointed out that a customer using energy a part of the time is less profitable from the central-station standpoint than one who uses a smaller amount continuously.

A Letter That Is Stimulating Interest in Electric Cooking.

Newspapers in the suburbs of Boston are publishing, as a news feature, the accompanying letter relative to electric ranges, copy being supplied by the Edison Electric Illuminating Company of Boston. Prepared in letter form, the copy is of greater length than would be suitable for an advertisement and it has the added advantage of being different from the usual electric-range copy. The text is as follows:

Dear Harriet—After visiting you and seeing what a dear little home you had, I could not help but think that all it needs to make it complete is an electric range, especially during these hot summer days when you want to keep your house cool and clean with very little exertion.

If you cooked by electricity, you would never be bothered with coal or smoke or ashes. Your pans and kettles would not become blackened, as electric heat is a clean heat. For you who do your own work, this would be a very desirable feature.

Just think how cool your kitchen would be if you cooked with electricity! You would never be overheated working over a hot stove in a hot kitchen. In an electric range the heating units are so insulated that the heat cannot escape into the kitchen, but is every bit utilized upon the article being cooked.

The ease with which you can operate an electric range is a continual source of joy. There is no raking or poking a fire; not even the striking of a match—merely the turn of a switch, and any one of three heats is at your service. Can you think of anything more convenient? Electric heat is always ready, and the degree of heat never varies.

A great many people would like to have an electric range but they have an idea that it is very expensive. Perhaps you have this same idea. There has been such a demand for electric ranges by people of moderate means, that the Edison Company now sells them on the easy payment plan—that is, a small sum paid down and the rest in small monthly payments. Since the present low rate of the Boston Edison Company for electricity for heating and cooking purposes has been in effect, the cost to operate an electric range is very reasonable; in fact, so reasonable that over 1,000 have been installed around Greater Boston since last October.

During the month of August the company is selling a new range, the regular price of which is $20, for $15. This would be very convenient for you, as it takes up very little room and can be set on a table when in use, and when not in use can be put anywhere out of the way.

Why don't you drop in at the Edison Light Store and look at it? They will be very glad to demonstrate it and answer any questions you may have. Lovingly, Mary.

Renting Value of Wired Houses Shown By Advertisement.

A very forceful advertisement of the Boston Edison Company is being carried by the local daily newspapers on their real estate pages.

The text matter calls attention to the fact that the landlord who owns unwired houses or stores is a trailer in the race when it comes to renting the property.

Electrical equipment in a house not only increases its renting value and opportunity; it also lends an increment to its selling value which is greatly in excess of the cost of the installation, the advertisement points out.

Wire for Electricity
The landlord or homeowner
who has not wired his building for Electric Light is not only blind to his tenant's or his own comfort; he is missing a first-class investment — one which will yield large and certain returns, from the very start.
The Electrically Wired House Brings a Higher Rental — Sells Quicker
Electric wiring adds a definite
value to your house for either prospective tenant or purchaser. People are demanding a "modern" house nowadays. They are willing to pay more — to stay longer. You get a better class of tenants. You save on redecorating costs. And you more readily find a buyer, should you wish to dispose of your property
Let us tell you about our Easy Payment house wiring plan. Free estimate on your property. Just phone Oxford 3300, Sales Department, and we will send a man to your address, or write for booklets.
The Edison Electric Illuminating Company of Boston
39 Boylston St. and 15 Suburban Stores

Advertisement of Boston Edison Company in Real Estate Columns.

WHY THE ELECTRIC RANGE HAS COME TO STAY.[1]

By R. A. MacGregor.

At first thought, "Why the Electric Range Has Come to Stay," seems to us to be more of a matter of fact than an innovation, for those of us who have spent any length of time in this service have learned that we must not be surprised at any new development in the business, for what was next to impossible a year ago is a fact (in use) today, so fast do we develop, manufacture and apply the newer things in our industry.

The development of the electric iron seems a long way back as we think of it today, but just imagine the years that have elapsed in the development of the plow. It has taken centuries to bring the plow of the Egyptian to the tractor of today, where 10 years have seen the complete development of the electric iron.

From the iron came the toaster, then the percolator, the grill, the cooker, the ovenette, and now the range; and what is the range? Nothing more than a combination of the grill, or disk stove, as the case may be, with the fireless-cooker principle, which has been in successful operations for years.

With this before us—and realizing that separately these appliances have come to stay—is there any question that they have come to stay when put together and incorporated in one piece of apparatus?

This, however, is not the only point from which this should be considered and I attach the following:

The range must be successful electrically—that is, stand up in regular service.

Again, the range must be successful domestically—that is, cook and bake in regular service dependably.

Again, the range must work at a point of profit to the consumer and the company in regular use for all the cooking the consumer needs.

Last, convenience and sanitation governs largely the range application.

Taking up these points as outlined, we have, first—Will the range stand up in regular service? This seems foolish to consider when we think of the service we obtain from irons; and still we hear a great many questions asked along this line. If units are purchased of the proper voltage, their life should be long enough to overcome the possibility of any complaint in this regard. Don't forget some manufacturers are guaranteeing irons for years now, so the writer does not feel that this is a bugbear. In other words, among the ranges which have been on the market over two years no fault can be found along this line. If this were not so, the thousands of ranges now being shipped to the Far West and Pacific Coast cities would never have started.

Second—Is the range right for baking and cooking? The same argument as to the carloads of ranges going West applies here, and there is no question as to the successful domestic operations performed on most of the ranges now on the market which are purchased with regard to voltage to be delivered and then have the range supplied with that voltage.

Of course, we have the cry that the electric range is slow, and it is admitted by all that it is slower than a flame stove, but this is not a serious objection and is soon overlooked by the housewife when the other advantages are appreciated. We are certain to feel upon investigation that there is no doubt but what the electric range is successful domestically.

We will step over the financial side of this question for a moment and look at the convenience and sanitary side.

1—Abstract of a paper read before the Indiana Electric Light Association, at the Fort Wayne convention, September 13.

From a convenience standpoint all the old arguments that we have used in connection with the convenience side of electric lighting apply here. A twist of the wrist, a snap of a switch and you have light, no matches to be gnawed by rats, to be left for children to play with, and so on, used to be and still are our convenience arguments for electric light; change the word light to heat, and you have the same arguments to use here, to which is added, "Go shopping and let the range work while you're away." This applies to a greater or less degree, according as you are handling a range without automatic features, one with an automatic cut-off, or one with a full automatic turn-on or off feature.

As to sanitation, the electric range is beyond argument the last word in sanitary cooking, for as for fumes, odors, gases, etc., arising from burning fuel, no matter whether it is coal, wood, kerosene, gasoline, gas or what-not, there is no burning or consumption of fuel, and consequently no fumes.

I feel that this fully disposes of reliability of construction, the practical uses, and the advantages of convenience and sanitation, and now we come to the real bugbear—both from the consumer's standpoint and that of the company, and that is: "Can ranges be used at a point of profit to the company and the consumer?"

Now, in the first place, we do not have to meet the bare fuel cost of present-day cooking methods any more than we have to meet the coal cost of a steam plant when selling electric power. Also, we must remember that in this age people are giving the benefits to be derived from a system, a process or an operation, more consideration than they ever did before. You know and I know that you cannot use an automobile at anything like the cost of riding behind "Old Dobbin" and still there are thousands in use. We can expect the same results with ranges as soon as education of the public reaches a point where the benefits are realized, and when it comes it will come fast.

Again, we cannot expect to obtain prices that are entirely beyond reason. From the company's side we must receive a return sufficiently large to return an adequate profit—but do not let us err in determining the cost upon which we wish to determine this profit.

Here in Indiana we are fortunate in having had our road blazed for us, although I am frank to say I am surprised to find, upon examining the report of our Range Research Committee, which sent out a list of 15 questions, that we are practically doing nothing along this road.

Doubtless many of you are still skeptic and feel that the electric range has a field only in the regions of high-fuel costs and low-price water-power electrical energy. If you do, you are wrong, for from last reports more progress has been made right over in the state of Illinois than any place in the country in the same area.

Indiana has practically the same conditions as Illinois and if ranges can be sold by the hundreds over there I feel sure that with the ability existing in Indiana, thousands can be sold and used at a cost for energy which is within the consumer's reach and at a profit to the central station.

Now what is such a price?

Data which have been published on thousands of ranges seem to prove conclusively that the ordinary family of four or five persons can do all its cooking on an electric ranges, copy being supplied by the Edison Electric four or five times more energy than they are now using for lighting and small appliances.

Again, we find that from three to four cents per kilowatt-hour (according to fuel costs in different localities) puts electric cooking within the reach of the majority of central-

station consumers, even where gas is 80 cents to $1 per 1,000 cubic feet.

Of course, it is not to be expected that the energy bill of $3 or $4, as the case may be, is the equivalent of the present gas bills at 80-cent to $1 gas. However, the increase is well warranted in the advantages offered in electric cooking, and, when eatable savings are taken into consideration, the over-all cost to the housewife will hardly exceed the cost under operation with fuels.

Even men in the business seem skeptical over the question of meat saving as claimed by range manufacturers, but they need not be, for the old fireless cooker has been doing the same thing for years. Again, the fact that a fireless cooker used in meat preparation admits of buying the cheaper, tougher cuts of meat and serving them tender and juicy as the finest porterhouse, or an old barnyard rooster who has ruled his roost for years served as tender as a springer, seems to have been lost sight of in range work, for what the old-time fireless would do can be done with nearly all electric ranges with the work and inconvenience of heating cooker disks left out.

Again, with automatic ranges a great deal more time is at the disposal of the housewife, which can be devoted to duties and pleasures much more pleasing than kitchen drudgery.

So we have, as has been demonstrated elsewhere, a big field for energy at three and four cents if we can afford to sell it at that price and I believe that practically every central station in the state of Indiana can so adjust its affairs as to make this possible.

We have chased madly after power business for small motors at four and five cents where extensions to primaries, transformers and meters were necessary, because we were increasing our load-factor and selling off-peak business.

Here we have an outlet at our door which does not require primary extension and where, while it seems advisable to start this business by installing a separate transformer, if necessary, and giving the customer a separate meter until you have absolutely demonstrated the economy of electric cooking—later when sufficient business is developed, you will find that lighting and cooking current will be supplied from the same transformer banks, slightly increased, and the same secondaries and meters. These facts are all being proven by the western companies and data to this effect can be found in the report of the Range Committee[2] of the Northwest Electric Light and Power Association, as well as in the report of a similar committee of the National Electric Light Association.[3]

I want to call your attention to the fact that while the individual range may show a demand of three kilowatts, the diversity-factor of this load between consumers proves that this is much less per range when grouped with other ranges and that a number of ranges grouped together with lighting customers does not increase the maximum demand much over that of the lighting demand of these customers. This then proves conclusively that range business is off-peak and will better the load-factor on the station, which in turn means lower manufacturing costs. This taken into consideration with the fact that you have now made large investments in every case of poles, lines, transformers, meters, etc., and in nearly all cases in generating equipment against which interest, depreciation charges and taxes are continually going on, which installation may be made to increase its earning power from 300 to 400 per cent by a small additional investment equal to about one-tenth of what you now have per dollar of annual revenue and I am sure you can see your way clear to go after range business at a price that will get it and keep it.

Now I know that when I have finished a number of you, and particularly those of you who are buying energy, will tell us you can't do it because your present costs are above these figures. Well, before you condemn me for advocating what I have here, ask yourself why your costs are what they are. It is load-factor and that alone. Remember the miller can take an old slide-valve engine and run his flour mill with very little attention to maintenance or fuel economy, run it non-condensing and beat these figures all hollow and he doesn't have to have a very big mill either, at least one not as large as the majority of central stations represented here. If you are buying energy that will not admit of lower cost as the load-factor is increased, or off-peak business taken on, you are off on the wrong foot and have made a mistake in arranging for your supply, so don't throw cold water on one of the best opportunities this business has ever had to again increase in leaps and bounds.

Another thing it has always been hard to make the general public understand is why 10 and 12 cents should be charged for electric light in the home and then be sold to the storekeeper for six and to the power user for two, three and four. This differential is too great for him to grasp and he shouts "robbers," and immediately agitates municipal operation with its misleading figures. Now, if you can sell him 20 kilowatt-hours at 10 cents and 100 at four cents, you reverse the argument to where his 120 kilowatt-hours costs $6 or five cents each. Make him help you to help him get his energy where he can't complain and don't let this golden opportunity slip by another day without taking a vigorous hold and helping to increase range sales to where production will decrease the cost of ranges to a point where nobody can complain. I know we all think electric ranges cost too much, but we are not going to get them any cheaper until there are enough being manufactured to make quantity production an item that will reduce manufacturing costs and selling expense, which are at present holding up the cost of ranges. You can sell some ranges at the present price (not as many, no doubt, as you could sell at a lower price) but don't forget you won't sell any if everybody waits for the lower price. Get busy and sell your few and help get the cost down for everybody.

This field is astounding and the opportunity enormous to everyone of you for additional business. In the city of Indianapolis alone there are prospects (some good and some bad, some swift and some slow, of course), for 45,000 electric ranges at 100 kilowatt-hours per month: this is a possible sale of 4,500,000 additional kilowatt-hours a month, or 56,000,000 kilowatt-hours a year, which at 3.25 cents would mean $1,820,000, or an increase of over 81 per cent of the present earnings from central-station operation in that city. The same condition exists all over the state. Isn't it worth while going after, even if you get but a few ranges this year? One company on the Pacific Coast which sold but 100 ranges the first year, which was three years ago, had ordered 2,500 ranges for the year 1916 and expected to place every one of them.

In order to arrive at the activities along this line in this state, the Range Research Committee of this Association, M. V. Stagg, chairman, sent out a list of 15 questions to the 66 companies in the state. Replies were received from 41 companies, 25 of whom reported they had done nothing and had no ranges on their lines.

Taken all together, this shows that Indiana has not done much along this line as yet, although the majority of ideas expressed in the answers are in line with the policies found best by more experienced companies elsewhere.

2—See ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, September 18, 1915, pages 501, 534, 535. Also September 16, 1916, pages 497, 498.

3—See ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, May 27, 1916, pages 959, 975.

POWER ENGINEERING

Problems Involving Motor Applications, Machine Characteristics, Power Sales Methods and Industrial Electric Heating

SALE OF POWER TO IRON AND STEEL MILLS.

Over 300,000,000 Kilowatt-Hours Per Year Now Used in This Industry and Amount Is Rapidly Increasing

The sale of central-station power to steel mills is one of the most vital questions today, particularly in those localities where continued prosperity has made it practically impossible for the mills to keep abreast of the orders. Practically every steel mill has during the past few months investigated means of increasing facilities and in not a few cases central-station service has been adopted, at least as the motive power in new departments and in cases where extreme operation has taxed the capacity of the private plant.

At the convention of the Association of Iron and Steel Electrical Engineers, held in Chicago, September 18 to 22, the question of central-station power for steel mills was one of the most important topics discussed and some valuable data were presented. In regard to central-station rates for this service, the rate schedules of 20 power companies furnishing power to steel mills were obtained, and the principal parts of these schedules are shown in table No. 1. To permit comparisons the net resultant rate for 1,000-kilowatt and 5,000-kilowatt loads at 50 per cent load-factor were calculated, which calculations gave the following results:

NET RATES PER KILOWATT-HOUR 50 PER CENT LOAD FACTOR. (CENTS).

	Maximum	Minimum	Average
1,000-kw. demand	1.246	0.700	0.9417
5,000-kw. demand	1.060	0.667	0.8464

The divisions according to frequency are as follows:

60 cycles	10
25 cycles	9
25 or 60 cycles	2

Two power companies make a 10 per cent lower rate for 25-cycle current than for 60-cycle current, due to their main source of water power being 25 cycles.

The power-factor required, if any is specified, varies from 60 per cent to 90 per cent. Eight out of a total of 11 require 80 per cent to 90 per cent, three 60 per cent to 75 per cent, and 11 make no reference to power-factor. It is noticeable, however, that the average rates of those having power-factor specified are lower than those which ignore power-factor.

The form of rate schedules are many and vary from flat

TABLE I—RATES CHARGED BY VARIOUS CENTRAL STATIONS FOR STEEL-MILL SERVICE.

No.	Cycles	Voltage	Power Factor	Demand Charge	Peak Period	Energy Charge	Discounts	Minimum Charge	Term	Net Rate—50% Load Factor 1,000 kw.	Net Rate—50% Load Factor 5,000 kw.	Special Conditions
1	60	11,000	60-75	1,000 kw.—$1.625 per kw. 1,500 kw.— 1.50 per kw. 2,000 kw.— 1.375 per kw. 2,500 kw.— 1.25 per kw. 3,000 kw.— 1.125 per kw. 4,000 kw.— 1.00 per kw.	Average Weekly 60-minute integrated peak	First 2,500 kw. hrs.—2.0c Next 25,000 kw. hrs.—0.8c Next 310,000 kw. hrs.—0.5c Next 2,642,500 kw. hrs.—0.4c All over 3,000,000 kw. hrs.—0.35c	None	$12.50 per year per kw of highest demand	3 years	0.980c	0.700c	3% off gross bill for primary metering, consumer owning transformers. 10% off on current used by synchronous motors when approved by power company
2	60	2,300			5-min. integrated peak							No rate information obtainable
3	25	13,000	90	None	Highest 5-minute integrated peak or 40% of highest instantaneous peak	Load Factor / Rate 10% / 3.0c 10-15% / 2.5c 15-20% / 1.65c 20-30% / 1.3c 30-40% / 1.2c 40-50% / 1.005c 50-60% / 0.85c 60-70% / 0.74c Over 70% / 0.6c	Gross / Disc. / Gross / Disc. $ 250 / 1% / $1,750 / 11% 400 / 2% / 1,900 / 12% 550 / 3% / 2,100 / 13% 700 / 4% / 2,360 / 14% 850 / 5% / 2,500 / 15% 1,000 / 6% / 2,800 / 16% 1,150 / 7% / 3,200 / 17% 1,300 / 8% / 3,750 / 18% 1,450 / 9% / 4,800 / 19% 1,600 / 10% / 5,300 / 20%			0.720c	0.704c	
4	60	13,000		200 kw.— $2.00 per kw. 200-1,000 kw.— 1.50 per kw. 1,000-2,000 kw.—1.42 per kw. Over 2,000 kw.— 1.35 per kw.	30-minute peak	200 kw. demand— 0.8c 200-1,000 kw. demand— 0.7c 1,000-2,000 kw. demand 0.6c Over 2,000 kw. demand 0.5c	None			1.203c	0.964c	Rates are for 60-cycle secondary service. Demand based on 30-min. peak, 4 to 5 p. m. Nov., Dec., and January No decrease in demand
4	25	13,000		10% below 60 cycle rate	30-minute peak	10% below 60 cycle rate	None			1.083c	0.868c	
4	25	13,000		20% below 60 cycle rate	30-minute peak	20% below 60 cycle rate	None			0.964c	0.772c	25-cycle service, unsupplemented by steam plt.
5	25	6,600	90	100-300 kw.—$2.00 per kw. Over 300 kw.—1.33½ per kw.	30-minute peak	100-300 kw. demand 1.0c Over 300 kw. demand 0.75c	5% Cash			1.00c	1.00c	Consumer owns transformers
6	25-60	13,200		First 200 kw.—$1.50½ per kw. Next 800 kw.— 1.25 per kw. Over 1,000 kw.— 1.00 per kw.	Highest 5-minute peak of monthly but not less 70% highest previous peak	0.5c kw. hr.	5% on First $25.00 1% on all over $25.00.	$250.00 demand		0.850c	0.758c	
7	60	Primary	70	First 200 kw.—$1.70 per kw. Excess over 200 kw.—$1.30 kw.	Average of 3 daily 5-minute integrated peaks	First 30,000 kw. hrs.— 1.25c Next 70,000 kw. hrs.— 0.70c Next 400,000 kw. hrs.— 0.50c Over 500,000 kw. hrs.— 0.45c	3% Cash	Highest previous demand but not less than $3.40	5 years	0.995c	0.85c	Demand based on highest previous demand until higher demand obtained
8	25	11,000	85	50-100 h.p.— $20.00 h.p. yr. 100-500 h.p.— 22.00 h.p. yr. 500-1,000 h.p.— 19.00 h.p. yr. Over 1,000 h.p.— 18.00 h.p. yr.	Average daily 1-minute peaks	None	None	60% of highest previous 1-min. peak	5 years	0.70c	0.667c	
9	60	13,200		None	Highest previous 30-minute peak	Load Factor / Rate 20.6% / 1.3c 22.8% / 1.25c 25.0% / 1.20c 29.0% / 1.15c 33.6% / 1.10c 38.1% / 1.05c 41.0% / 1.00c	None	Guaranteed hours use at which rate is based		1.00c	1.00c	Rates are for 225 kw. or more
10	25	12,000 to 60,000	90		Average daily 1-minute integrated peak							No rate information obtainable
11	25	13,000		First 200 kw.—$1.67 per kw. Next 800 kw.— 1.25 per kw. Over 1,000 kw.— 1.00 per kw.	15-min. integrated peak	0.4c	5% on first $13.00 1% on all over $23.00	Annual demand $4,000.00	3 years	0.763c	0.630c	No demand less than 70% of highest previous demand
12	25	2,300		$1.33 per kw.	30 min. integrated peak	First 15,000 kw. hrs.—$150.00 Excess over 15,000 kw. hrs.—0 0c	5% Cash	$1.25 per kw. contracted for		0.916c	0.903c	
13	60	4,800		$1.00 per kw.	Average 3 highest 3-min. peaks	1.0c per kw. hr.	27½ off energy charge	$20,000 year		0.95c	0.95c	
14	60			$1.62 per kw.	1-minute peak	0.97c gross	10-20% quantity 5% primary 10% cash		1 year	0.89c	0.870c	
15	60	Secondary	85-90	First 100 kw.—$1.00 per kw. Over 100 kw.— .50 per kw.	5-minute peak	First Block— 2.2c Second Block— 1.1c Excess Block— 0.5c	7 mills from 2.2c part. 1 mill from 1.1c part. None from 0.5c part.	Demand charge		0.87c	0.797c	
16	25-60	Secondary		First 50 h.p.—$20.00 h.p. yr. Excess— 40.00 h.p. yr.	Average 5-min. daily peak	None	None	Demand charge		1.248c	0.99c	
17	60	Primary	80	First 100 kw.—$250.00 Excess 1.33 per kw.	Max. 15-min. peak	First 50,000 at 1.0c Excess at 0.7c	2 mills per kw. hr.	Demand charge for highest previous peak	5 years	0.996c	0.887c	
18	25	Secondary	80	First 2,000 kw. at $1.573 kw. Excess at 90c kw.	Max. 15-min. peak	0.675c	5% off energy for cash	$0.873 per kw. connected	5 years	0.93c	0.90c	25-cycle unsupplemented by steam plant, 10% lower
19	60	22,000	75	First 1,000 kw. at $1.25 kw. Excess at $1.00 kw	Ave. weekly 60-min. peak	First 100,000 kw. hr. at 0.9c Next 150,000 kw. hr. at 0.45c Excess at 0.4c	None	120 hours use of demand		0.90c	0.722c	
20	60	Primary		$1.33 per kw.	Average 5 highest 5-min. peaks	1.0c per kw. hr.	10-40%			0.91c	0.85c	Complete information unavailable, net rate approximate

rates per horsepower-year, regardless of energy consumption, to those having complicated demand and energy rates and more complicated discounts. The majority of the schedules, however, have separate demand and energy charges, each of which charges may be in from one to six steps. For demand systems of charging, the peak period varies from one minute to 60 minutes, some are integrated peaks, some sustained peaks, while others do not state how the peak shall be determined.

Load-factor and power-factor play such important parts in the cost of manufacturing and distributing electric service, that minimum power costs cannot be obtained without taking these two factors into the calculations. The demand, including the effect of power-factor upon it, is just as important a part of a proper rate schedule as is the energy charge. A mill, with a load-factor of 70 per cent and a power-factor of 80 per cent or better, can be served at very much less cost than another mill having a load-factor of 35 per cent and a power-factor of 50 per cent to 70 per cent, and should not be required to pay an average rate that would be penalizing the mill with a good load for the sins of the mill having a poor load condition.

Rate schedules should be as simple as possible and avoid complicated systems of rates and discounts for varied load-factors and consumptions. Where the case can so adjust its operations as to permit keeping off the central-station peak, there should be a lower rate than for peak service. Some of the power companies reporting, charge only 50 per cent of the peak demand rates for off-peak service only.

While the difference in operating costs of the power companies will not permit of uniform rates for all, their costs all follow the same general lines and with different figures to fit different conditions, standard forms of rate schedules and contracts could easily be made to cover all companies. To this end it is recommended that in negotiations for central-station power service and in order to obtain most favorable rates to the purchaser, it be insisted that the rate schedule be divided into demand charges and energy charges; that the demand be the average or integrated peak of 15 to 30 minutes' duration; that the power-factor be 80 per cent with decrease or increase in the demand to be charged for accordingly as the power-factor is above or below 80 per cent; that the demand charges per kilowatt be in two or more steps; that the energy charges per kilowatt-hour be in two or more steps; that any excess demand occurring at other than the peak period of the power company's plant be charged at only one-half the demand charge normally applying for such excess, if occurring on the power company's peak period.

The use of purchased power by steel companies is rapidly increasing, the total as shown in table No. 2 being more than 300,000,000 kilowatt-hours per year. During the last two years approximately 50 per cent of the motor units applied to main rolls were connected to central-station companies' lines, and the percentage of power used by them as compared with power for the total of motors on main rolls has increased from 12 to 18 per cent.

The number of companies using purchased power and the long period of many of the contracts is a strong recommendation, in particular from the standpoint of reliability. The power rate is favorable as compared with the cost of generating power, in a large majority of industrial plants. The use of purchased power often facilitates the completion of improvements, especially in the case of the remodelling of a plant, eliminates the extra supervision and care of a power station, and is a material factor in reducing first cost.

TABLE II—LIST OF PROMINENT STEEL MILLS PURCHASING POWER FROM CENTRAL STATIONS.

No.	Name of Steel Plant	Location	Name of Power Company	Approx. K. W. Hrs. Per Year	Cycles	Character of Driven Machines	Date of Contract
1	Seneca I. & S. Co.	Buffalo, N. Y.	Nia., Lockport & Ont. Pr. Co.	10,000,000	25	Two-Sheet Mill & Aux. Motors	1908
2	Lackawanna Steel Co.	Buffalo, N. Y.	Nia., Lockport & Ont. Pr. Co.	50,000,000	25	Main Roll & Aux. Motors	1907
3	Ontario I. & S. Co.	Welland, Ont.	Nia., Lockport & Ont. Pr. Co.	4,000,000	25	Main Roll & Aux. Motors	1908
4	Kansas City B. & N. Co.	Kansas City, Mo.	Kansas City Elec. Lt. Co.	3,000,000	25	Main Roll & Aux. Motors	1913
5	Minnesota Steel Co.	Duluth, Minn.	Great Northern Power Co.	4,000,000	25	Aux. Motors & Emerg. Service	1915
6	St. Louis Screw Company	St. Louis, Mo.	Union Elec. Light & Power Co.	2,000,000	25	Main Roll & Aux. Motors	1913
7	Simonds Manufacturing Co.	Lockport, N. Y.	Lockport Lt., Ht., & Pr. Co.	3,000,000	25	Main Roll & Aux. Motors	1906
8	Illinois Steel Co.	South Chicago, Ill.	Commonwealth Edison Co.	30,000,000	25	Main Roll & Aux. Motors	1914
9	Halcomb Steel Co.	Syracuse, N. Y.	Syracuse Light Co.	1,500,000	25	M. R. & Aux. M. & Elec. Furnace	1906
10	Crucible Steel Co. of America	Syracuse, N. Y.	Syracuse Light Co.	1,000,000	25	Main Roll & Aux. Motors	1910
11	Laclede Steel Co.	Alton, Ill.	Alton Gas & Elec. Co.	6,000,000	25	Main Roll & Aux. Motors	1913
12	Nat. Enamel. & Stamping Co.	St. Louis, Mo.	Union Gas & Elec. Co.	500,000	25	Aux. Motors	1914
13	Bethlehem Steel Co.	S. Bethlehem, Pa.	Lehigh Navigation Elec. Co.	35,000,000	25	Main Roll & Aux. Motors	1915
14	Maryland Steel Co.	Sparrows Pt., Md.	Con. Gas & Elec. Co. (McCall's Ferry Plant)	20,000,000	25	Auxiliary Motors	1913
15	Apollo Steel Co.	Apollo, Penna.	West Penn Traction Co.	5,000,000	60	Sheet Mill & Aux. Motors	1912
16	Carnegie Steel Co. (Painters Mills)	Pittsburgh, Pa.	Duquesne Light Co.	10,000,000	60	Main Roll & Aux. Motors	1911
17	United Steel Co.	Canton, Ohio	Canton Light & Power Co.	60,000,000	60	M. R. & Aux. M. Elec. Furnace	1912
18	Canton Sheet Steel Co.	Canton, Ohio	Canton Light & Power Co.	5,000,000	60	Sheet Mill & Aux. Motors	1915
19	Timken Roller Brg. Co.	Canton, Ohio	Canton Light & Power Co.	7,000,000	60	M. R. & Aux. M. Elec. Furnace	1915
20	Trumbull Steel Co.	Warren, Ohio	Trumbull Pub. Ser. Co.	7,500,000	60	Sheet M. & Aux. Motors	1916
21	Western Reserve Steel Co.	Warren, Ohio	Trumbull Pub. Ser. Co.	5,000,000	60	Sheet M. & Aux. Motors	1914
22	Empire Rolling Mill Co.	Cleveland, Ohio	Cleveland Elec. Illum. Co.	5,000,000	60	Sheet M. & Aux. Motors	1915
23	Upson Nut Co.	Cleveland, Ohio	Cleveland Elec. Illum. Co.	4,000,000	60	Main Roll & Aux. Motor	1914
24	Central Steel Co.	Massillon, Ohio	Massillon Gas & Elec. Co.	9,000,000	60	Main Roll & Aux. Motor	1915
25	Peerless Drawn Steel Co.	Massillon, Ohio	Massillon Gas & Elec. Co.	1,000,000	60	Cold Drawing Motor	1914
26	Morris-Bailey Steel Co.	Wilson Sta., Pa.	Duquesne Light Co.	5,000,000	60	Cold Roll & Aux. Motor	1910
27	Standard Tin Plate Co.	Canonsburg, Pa.	West Penn Traction Co.	7,000,000	60	Sheet Mill & Aux. Motor	1915
28	American Steel & Wire Co.	Worcester, Mass.	Comm. R. Traction Co.	5,000,000	60	Aux. Motor	1913
29	Baltimore Sheet & Tube Co.	Baltimore, Md.	Cons. Gas & Elec. Co.	10,000,000	60	Sheet Mill & Aux. Motor	1916
30	Llewellyn Iron Works	Los Angeles, Cal.	S. Cal. Edison Co.	7,000,000	50	Main Roll & Aux. Motor	1916
31	Chattanooga Steel Co.	Chattanooga, Tenn.	Chat. & Tenn. R. Power Co.	10,000,000	60	Main Roll & Aux. Motor	1916
32	Ashland Iron & Min. Co.	Ashland, Ky.	Ohio Valley El. Ryl Co.	10,000,000	60	Main Roll & Aux. Motors	1916
33	Youngstown I. & S. Co.	Youngstown, Ohio	Mahoning & Shenango Rwy.	7,500,000	60	Main Roll & Aux. Motors	1914
34	Shelby Tube Company	Elwood City, Pa.	Mahoning & Shenango Rwy.	5,000,000	60	Main Roll & Aux. Motors	1915
35	Union Rolling Mill Co.	Cleveland, Ohio	Cleveland Elec. Illum. Co.	4,200,000	60	Main Roll & Aux. Motors	1914
36	Gulf States Steel Co.	Alabama City, Ala.	Alabama Power Company	13,500,000	60	Main Roll & Aux. Motors	1914
37	Universal Rolling Mill Co.	Bridgeville, Pa.	Duquesne Light Co.	1,000,000	60	Main Roll Motors	1916
38	Witherow Steel Co.	Pittsburgh, Pa.	Duquesne Light Co.	1,000,000	60	Main Roll & Aux. Motors	1916
39	Monongahela I. & S. Co.	Pittsburgh, Pa.	Duquesne Light Co.	1,000,000	60	Main Roll & Aux. Motors	1916
*40	Pennsylvania Steel Co.	Steelton, Pa.	York Haven Water & Pr. Co.	5,000,000	60	Main Roll & Aux. Motors	1908
41	Carpenter Steel Co.	Reading, Pa.	Metropolitan Elec. Co.	5,000,000	60	Auxiliary Motors	1911
42	Standard Steel Works	Burnham, Pa.	Penn. Central E. L. & P. Co.	5,000,000	60	Auxiliary Motors	1915
43	Central Iron & Steel Co.	Harrisburg, Pa.	Harrisburg Lt., Ht. & Pr. Co.	1,500,000	60	Auxiliary Motors	1910
44	Harrisburg Pipe & P. B. Co.	Harrisburg, Pa.	Harrisburg Lt., Ht. & Pr. Co.	5,000,000	60	Auxiliary Motors	1915
45	Midvale Steel Co.	Philadelphia, Pa	Philadelphia Electric Co.	10,000,000	60	Auxiliary Motors	1916
46	Parkersburg Iron Co.	Parkersburg, Pa.	Chester Vy. E. L. & P. Co.	1,000,000	60	Auxiliary Motors	1916
47	Eastern Steel Co.	Pottsville, Pa.	Eastern Pa. E. L. & P. Co.	5,000,000	60	Main & Aux. Motors	1916
48	Phoenix Iron Wor s	Phoenixville, Pa.	Phila. & Suburban E. L. Co.	1,000,000	DC	Auxiliary Motors	1906
49	American I. & S. Man'f'g Co.	Reading, Pa.,	Metropolitan Elec. Co.	3,000,000	60	Auxiliary Motors	1913
50	Atlantic Steel Co.	Atlanta, Ga.	Georgia Ry. & Power Co.	5,000,000	60	Main & Aux. Motors	1912
51	Tenn. Coal, I. & R. R. Co.	Bessemer, Ala.	Alabama Power Co.	2,000,000	60	Auxiliary Motors	1915

*Frequency Changer used to give 25 Cycle power for plant.

ELECTRICAL CONSTRUCTION

A Department Devoted to Problems Relating to the Installation, Operation and Maintenance of Electrical Equipment

Wiring for Mercury-Vapor Lamps.

Mercury-vapor lamps are available for both direct and alternating-current circuits. Although the former method of tilting the lamp to start it has not been entirely superseded, most of the lamps installed at the present time are provided with an apparatus which starts the lamp in operation by causing a spark to jump between the mercury terminal and a starting band which is placed around the tube near the end. The wiring diagram and method of starting given in the article on page 248 of the issue of August 5 applies to some lamps now in use, but to few or none that will be installed in the future.

Fig. 1 shows the wiring diagram for a direct-current type P lamp as furnished by the Cooper-Hewitt Electric Company. The resistance provided is suitable for circuits of 100 to 124 volts. Individual switches should be provided for each lamp outfit and the lamp should be fused for 10 amperes, although the normal current is but 3.5 amperes. Extreme care must be taken to connect the supply wires with the proper polarity.

The auxiliary which is supplied with the lamp and which supports it is rigidly fastened to the ceiling. The auxiliary contains an adjustable resistance which must be set for the actual voltage of the circuit. Each auxiliary contains a shifter which serves for starting the lamp in operation. This shifter is shown in Fig. 1. When the shifter is properly placed the mercury forms a bridge between the two cups of mercury into which the two platinum leading-in wires penetrate. When current is supplied the magnetic coils lift the armature. The shifter is thereby turned in

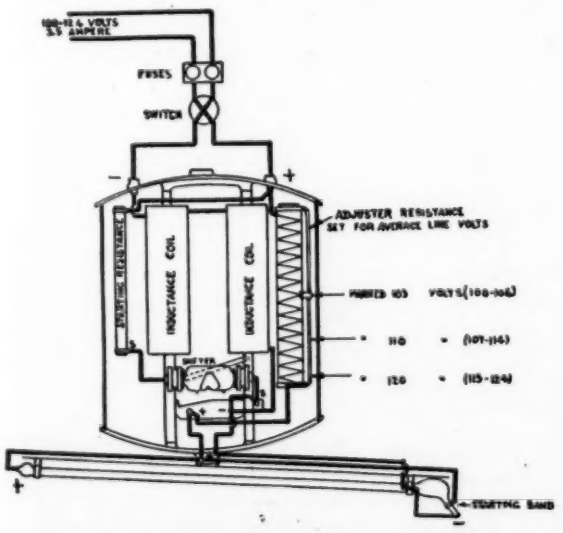


Fig. 1.—Wiring Diagram for Type P Lamp.

its bearings, the mercury bridge between the leading-in wires breaks and a spark passes between the starting band on the lamp tube and the mercury, and the lamp lights up.

Fig. 2 shows the diagram of the type F lamp for alternating-current circuits, in which the method of starting is the same as for the direct-current lamp.

Care should be taken to run the tube in the correct position which is one with the length inclined to the horizontal

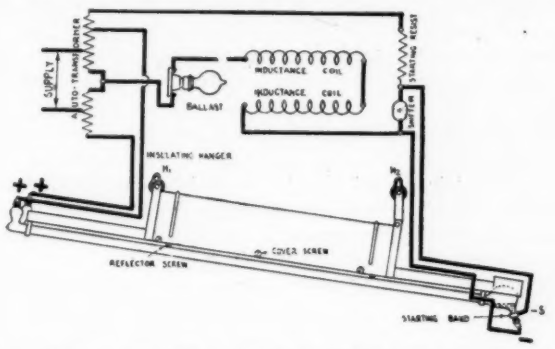


Fig. 2.—Wiring Diagram of Auxiliary Connections—Lamp Outfit in Position.

about seven degrees, the negative terminal being lower than the positive.

Freakish Causes of Transmission Line Troubles.

The Pacific Light & Power Corporation, Los Angeles, Cal., has been accurately recording freakish causes which have brought about high line shorts, and has recently issued the following data on this subject for the information of its employees.

Wind lifted tin roof from barn near high line at Magunden, blowing it across the line wire and ground wire. Light ground on West Big Creek line.

A rat climbing from top of potential transformer on Bradley line shorted line and burned lead off the transformer.

A squirrel on a cross-arm on the Kern line at Toll Gate Mountain got between line wire and ground wire—result, a shattered insulator and a shutdown on the Kern line.

A crane flying through the Pacific Electric Dominguez-Long Beach line shorted phases.

An owl flew into the North Sierra line between Sierra and Stone Castle, burning down one wire.

A pile driver pulled into the Ivanhoe and Hollywood lines, Pasadena Avenue, burning down both lines, and causing linemen to work all day putting up primaries and changing fuses on East Side.

Crow's nest on Kern line composed of sticks, wire, etc.—rain, pole on fire, short.

Cattle rubbing against guy stub shook line wire together on the Bradley line.

Sparrow hawk getting between line wire and ground wire on combination pole, burned both Los Angeles and Kern lines down, punctured current transformers on hospital line at Kern substation, and burned out meter wiring.

A lynx on cross-arm on Jurnpa line shorted phases.

Boys flew kite with wire in tail across line on Ellendale Street, shorting line.

Heat and smoke from fire under line resulted in short across phases on Kern line north of Newhall, also at Kern substation.

Polyphase Motor Windings—VIII

By Justin Lebovici

In discussing polyphase motor windings the author first took up closed two-layer windings, elucidating the presentation with examples and illustrations. This was followed with a consideration of open windings, which is continued in the present installment, attention being here given to lap windings in unequal groups. The next installment will deal with single-layer windings. In future installments windings for two speeds will be taken up and special attention given to the mechanical design of windings and to insulation.

Lap Windings in Unequal Groups.

It has been pointed out that the advantages of the wave winding are: (1) the number of connections between groups is reduced to a minimum; (2) it makes a neat winding; (3) it reduces the chances of the winder making a mistake, as compared with the lap windings in unequal groups.

When the number of turns per coil is great and the wire small, the lap style of end-connectors has generally the preference and the following discussion is intended to give the correct grouping of coils without going into the trouble of drawing up the winding table as has been done until now.

Since this class of windings is identical with the class of wave windings except for the shape of the end-connectors, we can generally state that any winding which will make a symmetrical wave winding will also make a symmetrical lap winding in unequal groups. The problem can also be looked upon from a different angle and a general rule can be derived for predicting if a given number of slots will make a symmetrical winding or not.

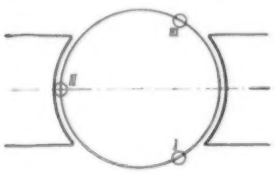


Fig. 94.

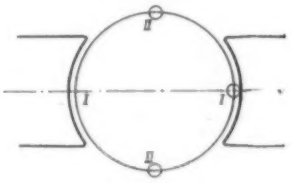


Fig. 95.

Fig. 94 shows a three-phase armature in a bipolar field, and it is evident that for an equal spacing of the slots the minimum number of slots that will make a balanced winding is three. Similarly, it is clear from Fig. 95 that four is the smallest number of evenly spaced slots that will make a balanced two-phase winding in a bipolar field.

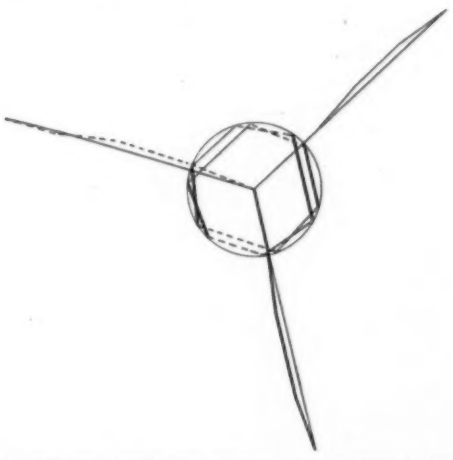


Fig. 96.—Winding Potential Diagram for Balanced Winding.

From Figs. 94 and 95 we deduce at once that for three-phase with two poles:

Number of slots/number of poles=3/2=n/2

For two-phase with two poles:

Number of slots/number of poles=4/2=2/1=n/1.

The winding will remain balanced if we multiply the numerator and denominator in above fractions by the same whole number K, or if we multiply the numerator by any whole number K_1, or if we multiply the denominator by any whole number K_2 not a multiple of n. We can then write quite generally:

For a symmetrical three-phase:

Number of slots/number of poles=$nKK_1/2KK_2$.

For a symmetrical two-phase:

Number of slots/number of poles=nKK_1/KK_2

Reducing the last two common fractions to their lowest terms we see that the numerator will remain a multiple of n in a balanced winding; the denominator may be any number after reduction. Hence the following rule: *Write the fraction: number of slots divided by number of poles, and reduce it to its lowest terms. If the numerator of the resulting fraction is a multiple of the number of phases the winding will be balanced (if properly arranged).*

For the proper arrangement of the coils in groups the number of slots per pole and phase, q, is of prime importance. Assume:

$$q=Z/2pn=W+N/K \quad \ldots\ldots (27)$$

where W, N and K are whole numbers. Putting $W+1$ coils in the first group, we make an error

$$(K-N)/K$$

which is a positive figure. Putting W coils in the second group, the error is reduced to

$$(K-2N)/K.$$

If $2N$ is smaller than K the error is positive and W is the correct number of coils in this group. If $2N$ is greater than K the error is negative and we will have to put $W+1$ coils in the group under consideration, the error becoming

$$(2K-2N)/K$$

and positive again. After K coil groups, the error becomes zero and the arrangement of coils repeats itself. There will be N groups of $W+1$ coils and $K-N$ groups of W coils per group, there being K groups total passed before the winding repeats itself.

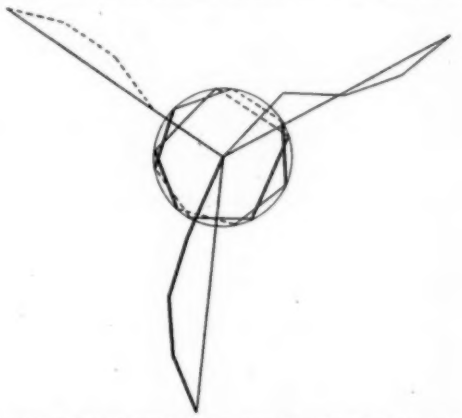


Fig. 97.—Winding Potential Diagram for Unbalanced Winding.

A few examples will help to make the application of the above rule clearer.

Example No. 32 (Same as Example No. 28).

A ten-pole machine has 36 slots, 36 coils, and it is proposed to wind it three-phase.

Z=36, p=5, n=3

$Z/2p$=36/10=18/5. Numerator 18=6×3=6×n

The numerator of the fraction, slots over poles, reduced to its lowest terms, being a multiple of n, the winding can be made into a balanced winding. From equation (27)

$$q=Z/2pn=W+N/K=36/30=1+1/5$$
$$W=1,\ N=1,\ K=5.$$

The winding will, according to the above rule, repeat itself after five groups and in this five groups there will be $N(=1)$ groups of $W+1(=1+1=2)$ coils and $K-N\ (=5-1=4)$ groups of $W\ (=1)$ coils per group. The arrangement is as follows:

Group	Coils per Group	Error
1	2	5/5—1/5=4/5
2	1	5/5—2/5=3/5
3	1	5/5—3/5=2/5
4	1	5/5—4/5=1/5
5	1	5/5—5/5=0

We can now write Table XXXI which is identical with Table XXIV. In this table the section which repeats itself is limited by the double line, II.

TABLE XXXI.

Poles	Phases I	II	III
1	2	1	1
2	1	1	2
3	1	1	1
4	1	2	1
5	1	1	1
6	2	1	1
7	1	1	2
8	1	1	1
9	1	2	1
10	1	1	1

The above method has been simplified by C. B. Taylor as follows. *Write in a horizontal row K groups of N figures. The groups containing the figures O, O+K, O+2K, etc., will take W+1 coils; all others will take W coils.*

1	2	3	K
0, 1, 2.....N-1	N.....2N-1	2N.....3N-1	N(K-1).....(KN-1)

In Example No. 32 we have $K=5$ and $N=1$. There are $N(=1)$ out of $K(=5)$ groups of W+1(=1+1=2) coils and $K-N(=4)$ groups of one coil per group. The groups of $W+1(=2)$ are in the columns containing 0, $0+K(=0+5=5)$, etc. But since the arrangement repeats itself after five groups, the group containing five falls in the first repeated division and does not interest us here. The part of the winding repeating itself is separated by a heavy horizontal line. The horizontal heavy line clearly shows the possible number of parallel circuits. We have:

	1	2	3	4	5
of $N=1$ figures:	0	1	2	3	4
$W+1(=2)$ coils per group,	2	1	1	1	1

.....K groups
the groups with 0, $0+K(=5)$ have
or the same arrangement as above.

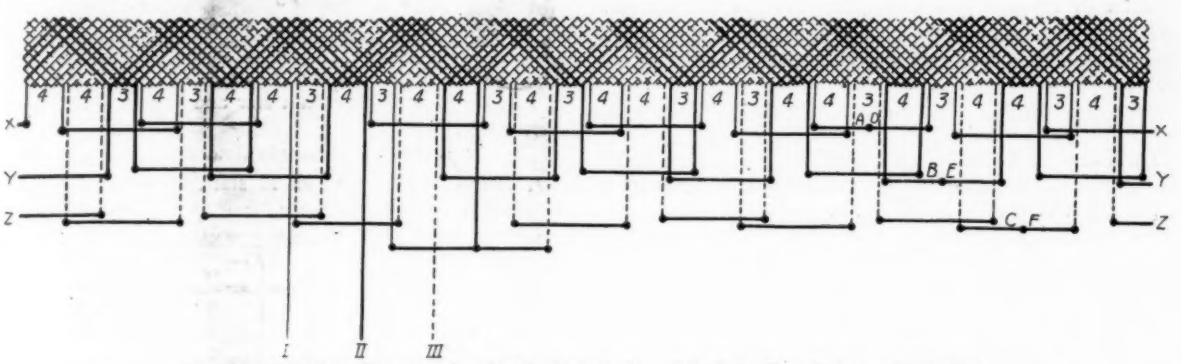


Fig. 98.—Winding Diagram for Single-Circuit Star Winding, Ten Poles and 108 Slots.
To change to double-star connection, cut leads at *AD, BE, CF*; and connect *A* to *I*, B to *II*, C to *III*; short-circuit *D, E, F*.

Example No. 33 (Same as Example No. 29).

A four-pole machine has 27 coils and it is proposed to wind it three-phase.

$$Z=27\quad p=2\quad n=3$$

$Z/2p=27/4$. Numerator of the fraction, slots over poles, reduced to its lowest terms, being a multiple of $n=3$, the winding will be balanced if properly arranged.

From (27),

$$q=Z/2pn=W+N/K=27/12=2+3/12=2+1/4$$
$$W=2\quad N=1\quad K=4$$

The winding will according to the rules given repeat itself after four groups. There will be one group of three coils and three groups of two coils per group in each repeating division.

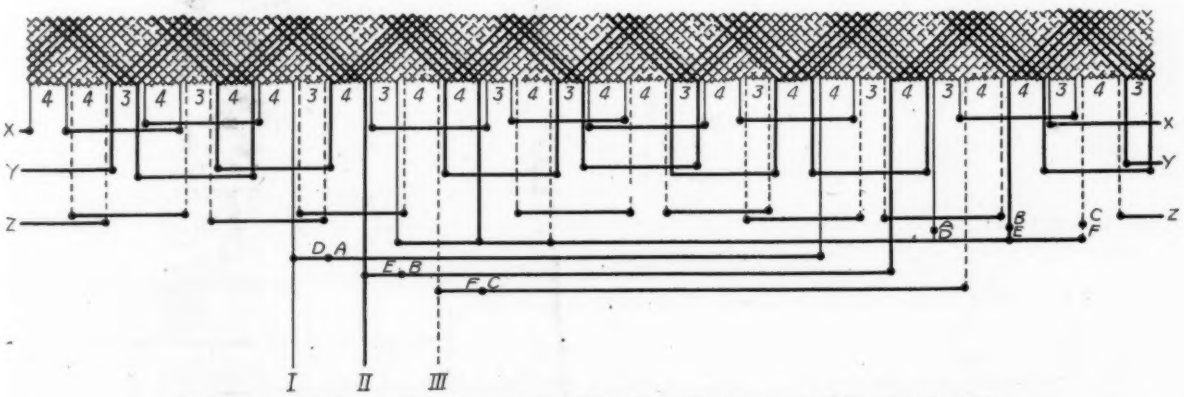


Fig. 99.—Winding Diagram for Double-Circuit Star Winding, Ten Poles and 108 Slots.
To change to single-star connection, cut leads at *AD, BE, CF*; and connect *A* to *A*, *B* to *B*, *C* to *C*. Tape *D*; *E*; *F*.

TABLE XXXII.

Poles	Phases I	II	III
1	3	2	2
2	2	3	2
3	2	2	3
4	2	2	2

We can then write Table XXXII at once. Table XXXII is identical with Table XXVI.

Example No. 34 (Same as Example 30).

An eight-pole machine has 54 slots, 54 coils, and it is proposed to wind same three-phase, star.

We have $Z=54 \quad p=4 \quad n=3$

$$Z/2p=54/8=27/4$$

Numerator of fraction, slots over poles, reduced to its lowest terms, being a multiple of $n=3$, the winding will be balanced, if properly arranged.

From equation (27),

$$q=Z/2pn=W+N/K=54/24=2+1/4$$

$$W=2 \quad N=1 \quad K=4.$$

There will be four groups in each repeating section, one group of three and three groups of one. We can write Table XXXIII which is identical with Table XXVIII.

TABLE XXXIII.

Poles	Phases I	II	III
1	3	2	2
2	2	3	2
3	2	2	3
4	2	2	2
5	3	2	2
6	2	3	2
7	2	2	3
8	2	2	2

The winding potential diagram is given in Fig. 96 and is drawn in the same way as Fig. 93, and needs no further explanation. The winding is balanced both as to voltage and phase displacement.

In order to show that the grouping of the coils has an important bearing on the balance of the winding, the winding potential diagram for the above example has been drawn in Fig. 97 for the grouping of coils which is given in Table XXXIV. It can be seen at a glance that the winding is unbalanced both as to voltage and phase displacement.

TABLE XXXIV.

Poles	Phases I	II	III
1	3	3	3
2	2	2	2
3	2	2	2
4	2	2	2
5	3	3	3
6	2	2	2
7	2	2	2
8	2	2	2

Example No. 35.

A ten-pole machine has 108 slots, 108 coils, and it is proposed to wind the same three-phase, star.

$$Z=108 \quad p=5 \quad n=3 \quad Z/2p=108/10=54/5$$

The numerator of the fraction, slots over poles, reduced to its lowest terms, being a multiple of n, the winding can be made into a balanced winding.

From equation **(27)**:

$$q=Z/2pn=W+N/K=108/30=3+18/30=3+3/5.$$

$$W=3, \quad N=3, \quad K=5.$$

The winding will repeat itself after five groups. There will be three groups of four coils per group and two of three coils per group. The arrangement is obtained as follows:

Group	Coils per Group	Error in One-fifth of a Slot Pitch
1	4	5/5— 3/5=2/5 Error positive.
2	4	10/5— 6/5=4/5 If we would have used three coils per group the error would have been 5/5—6/5=1/5 and according to our rule we want the error positive until the error becomes zero.
3	3	10/5— 9/5=1/5
4	4	15/5—12/5=3/5
5	3	15/5—15/5=0

We can write Table XXXV as follows.

According to the second method: Write in a horizontal row five groups of three figures. The groups containing the figures 0, 5 and 10 will take four coils per group, the others only three coils per group.

1	2	3	4	5
0, 1, 2	3, 4, 5	6, 7, 8	9, 10, 11	12, 13, 14
4	4	3	4	3

In place of writing all figures in the group it will be enough to write the first and last one, then we obtain:

1	2	3	4	5
0 to 2	3 to 5	6 to 8	9 to 11	12 to 14
4	4	3	4	3

The winding diagram using Table XXXV as a basis is drawn in Fig. 98 for a single-circuit star and in Fig. 99 for a double-circuit star.

Example No. 36.

A four-pole machine has 18 slots, 18 coils, and it is proposed to wind it three-phase.

TABLE XXXV.

Poles	Phases I	II	III
1	4	4	3
2	4	3	4
3	4	3	4
4	3	4	4
5	3	4	3
6	4	4	3
7	4	3	4
8	4	3	4
9	3	4	4
10	3	4	3

$$Z=18 \quad p=2 \quad n=3 \quad Z/2p=18/4=9/2$$

The numerator of the fraction, slots over poles, reduced to its lowest terms, is a multiple of n, hence the winding can be made into a balanced winding.

$$q=Z/2pn=18/2\times2\times3=W+N/K=1+1/2$$

$$W=1, \quad N=1, \quad K=2.$$

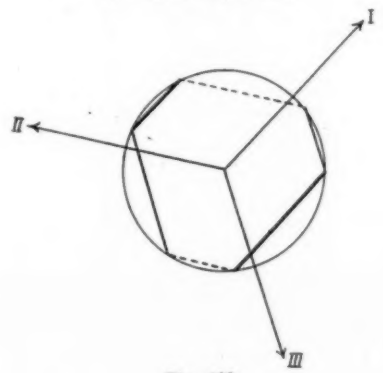


Fig. 100.

There will be two groups in each repeating section, one of two and one of one, and we can write at once Table XXXVI.

TABLE XXXVI.

Poles	Phases I	II	III
1	2	1	2
2	1	2	1
3	2	1	2
4	1	2	1

The fraction $N/K=\frac{1}{2}$ often occurs in practice and the winding potential diagram is very simple and instructive. It has been drawn up in Fig. 100 and it is seen that the winding is perfectly balanced as to voltage and phase.

Example No. 37.

A 20-pole machine has 144 slots, 144 coils, and it is proposed to wind it three-phase.

$$Z=144 \quad p=10 \quad n=3 \quad Z/2p=144/20=36/5$$

The numerator of fraction $Z/2p$, reduced to lowest terms,

being a multiple of three, the winding can be made into a symmetrical winding.

$$q=Z/2pn=144/60=2+2/5=W+N/K$$
$$W=2 \quad N=2 \quad K=5.$$

There will be five groups in each repeating section, two having 3 coils per group and three having 2 coils per group. Write K groups of N figures and the groups $W+1$ will be in the group containing O and $O+K=O+5=5$, the rest of the groups will have W coils per group.

1	2	3	4	5	K Groups
0, 1	2, 3	4, 5	6, 7	8, 9	
3	2	3	2	2	arrangement of coils in each repeating section

We can write Table XXXVII.[1]

We can arrange the winding single, double or four circuit, star or delta.

Example No. 38.

A 14-pole machine has 90 slots, 90 coils, and it is to be wound three-phase star.

$$Z=90 \quad p=7 \quad n=3 \quad Z/2p=90/14=45/7$$

The numerator of fraction, reduced to lowest terms, being a multiple of n, the winding can be made into a balanced three-phase winding.

$$q=Z/2pn=90/42=2+1/7=W+N/K$$
$$W=2, \quad N=1, \quad K=7$$

There will be one group of 3 and six groups of 2 coils per group in each repeating section and the Table XXXVIII can be written at once. Figs. 101 and 102 show the complete connection diagrams for winding these machines.

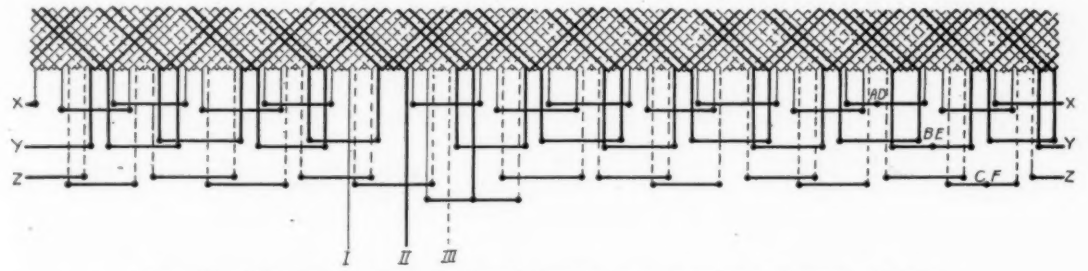


Fig. 101.—Winding Diagram for Single-Circuit Star Winding, 14 Poles, 90 Slots.
To change to double-star connection, cut leads at *AD, BE, CF*; and connect *A* to *I*, *B* to *II*, *C* to *III*; short-circuit *D, E, F*.

TABLE XXXVII.

Poles	Phases I	II	III
1	3	2	3
2	2	2	3
3	2	3	2
4	2	3	2
5	3	2	2
6	3	2	3
7	2	2	3
8	2	3	2
9	2	3	2
10	3	2	2
11	3	2	3
12	2	2	3
13	2	3	2
14	2	3	2
15	3	2	2
16	3	2	3
17	2	2	3
18	2	3	2
19	2	3	2
20	3	2	2

TABLE XXXVIII.

Poles	Phases I	II	III
1	3	2	2
2	2	2	2
3	2	3	2
4	2	2	2
5	2	2	3
6	2	2	2
7	2	2	2
8	3	2	2
9	2	2	2
10	2	3	2
11	2	2	2
12	2	2	3
13	2	2	2
14	2	2	2

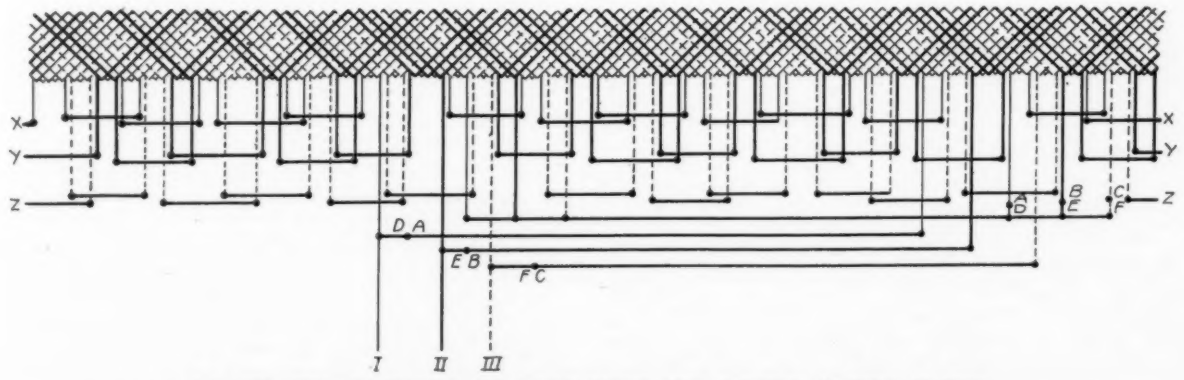


Fig. 102.—Winding Diagram for Double-Circuit Star Winding, 14 Poles, 90 Slots.
To change to single-star connection, cut leads at *AD, BE, CF*; and connect *A* to *A*, *B* to *B*, *C* to *C*; tape *D, E, F*.

Example No. 39.

A 12-pole machine has 56 slots, 56 coils, and it is to be wound two-phase.

$$Z=56 \quad p=6 \quad n=2 \quad Z/2p=56/12=14/3$$

The numerator of fraction $Z/2p$ reduced to lowest terms, being a multiple of n, the winding can be made into a balanced winding.

[1] This example is treated somewhat differently by E. M. Tingley in the already mentioned article in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN Vol. 66, No. 4, page 168.

$q=Z/2pn=56/2\times6\times2=56/24=2+1/3=W+N/K$

$W=2,\ N=1,\ K=3$

There will be one group of 3 and two groups of 2 in each repeating section and we can at once write Table XXXIX. The winding can be connected single, double or four circuit.

TABLE XXXIX.

Poles	Phases I	Phases II
1	3	2
2	2	3
3	2	2
4	3	2
5	2	3
6	2	2
7	3	2
8	2	3
9	2	2
10	3	2
11	2	3
12	2	2

The following two examples are intended to show that when the numerator of the fraction, slots over poles, reduced to its lowest terms, is not a multiple of the number of phases n, but the number of slots is a multiple of n, the same artifice can be used as explained in connection with wave windings to make a practically balanced winding.

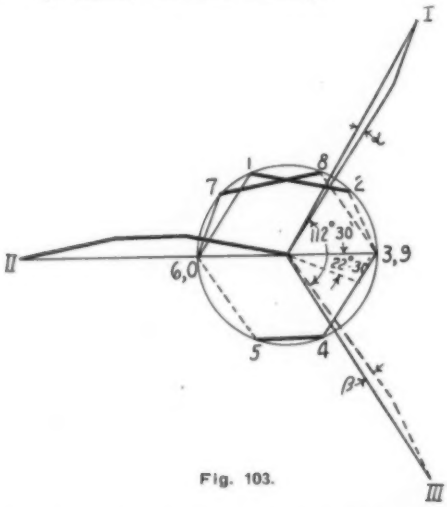


Fig. 103.

This can be done by using as basis for laying out the winding a slightly smaller number of slots than the core actually has and inserting the extra coils at the end of each repeating group.

Example No. 40 (Same as Example 31).

A six-pole machine has 24 slots, 24 coils and it is proposed to make a three-phase winding.

$Z=24\quad p=3\quad Z/2p=24/6=4/1\quad Z=3\times8=n\times8$

The numerator of the fraction, slots over poles, reduced to lowest terms, not being a multiple of n, it is not obvious that the winding can be connected to form a balanced winding.

Using 22 slots as a basis for our winding, we have

$q=Z/2pn=22/18=1+2/9=W+N/K\quad W=1,\ N=2,\ K=9$

The winding repeats itself after nine groups and we will add to the ninth group one coil. There will be $N+1(=3)$ groups of 2 coils and 6 groups of 2 coils in each repeating section. Groups containing figures O, O+9(=9) and the last group take $W+1$ coils. We can write

1	2	3	4	5	6	7	8	9	K
0,1	2,3	4,5	6,7	8,9	10,11	12,13	14,15	16,17	Groups containing 0,0+K, etc., and taking $W+1$ coils
2	1	1	1	2	1	1	1	2	Coils in each group

We can write Table XL, which gives the same winding potential diagram as Table XXX, although the rotation of vectors in each phase is a little different. The winding is not perfectly balanced, but small machines built in this way have proven satisfactory.

TABLE XL.

Poles	Phases I	Phases II	Phases III
1	2	1	1
2	1	2	1
3	1	1	2
4	2	1	1
5	1	2	1
6	1	1	2

Example No. 41.

A six-pole machine has 48 slots, 48 coils, and it is proposed to wind it three-phase.

$Z=48\quad p=3\quad n=3\quad Z/2p=48/6=8/1\quad Z=3\times16=n\times16$

The numerator of the fraction, slots over poles, reduced to lowest terms, not being a multiple of n, it is not obvious that the winding can be connected to a perfectly balanced winding.

Using 46 slots as a basis for our winding, we have

$Z=46\quad q=Z/2pn=46/18=2+5/9=W+N/K$

$W=2,\ N=5,\ K=9.$

The winding repeats itself after nine groups and we will add one coil to the ninth group. There will be $N+1(=6)$ groups of 3 coils per group and three groups of 2 coils per group. We can write:

Group	Coils per Group	Error
1	3	9/9— 5/9=4/9
2	3	18/9—10/9=8/9
3	2	18/9—15/9=3/9
4	3	27/9—20/9=7/9
5	2	27/9—25/9=2/9
6	3	36/9—30/9=6/9
7	2	36/9—35/9=1/9
8	3	45/9—40/9=5/9
9	2+1	45/9—45/9=0 add 1

From which follows arrangement shown in Table XLI.

TABLE XLI.

Poles	Phases I	Phases II	Phases III
1	3	3	2
2	3	2	3
3	2	3	3
4	3	3	2
5	3	2	3
6	2	3	3

Fig. 103 shows the winding potential diagram for one group of three poles. The vectors are plotted in the rotation 1—2—3—4—5—6—7—8—9.

The resultant voltages are as follows:

$I=III=\sqrt{(5\ \cos\ 22°\ 30'+3)^2+(1\ \sin\ 22°\ 30')^2}=\sqrt{7.620^2+0.333^2}=7.62.$

$II=6\ \cos\ 11°\ 15'+2\ \cos\ 33°\ 45'=6\times0.980+2\times0.831=7.53$

showing that the voltages are very nearly balanced.

The angle between phases I and II or

Angles $I—III=112°\ 30'+\alpha+\beta$

Angle II— I =Angle II—III$=123°\ 45'-\alpha$

$\tan\ \alpha=\tan\ \beta=\sin\ 22°\ 30'/5\ \cos\ 22°\ 30'+3=0.333/7.620=0.0438$

$\alpha=\beta=2°\ 30'$

Angle I—III$=117°\ 30'$

Angle II— I =Angle II—III$=121°\ 15'$

showing that the phase displacement between phases is not 120°, but the variation will be permissible in medium-sized electrical machinery.

It may be stated in conclusion of this discussion of the open lap and wave winding that a single-circuit practically balanced winding can always be obtained when the number of slots is a multiple of the number of phases n.

It is to be noted that the resultant voltage in a winding having a fractional number of slots per pole and phase is smaller than the resultant voltage would be for the same number of slots in a winding with a whole number of slots per pole and phase.

A machine with a fractional number of slots per pole and phase is the equivalent of a machine having a smaller number of poles and more slots per pole, meaning that the winding factor f_w, and in consequence the resultant voltage, is reduced.

Assume the case of a three-phase, ten-pole machine having a number of coils equal to the number of slots and the winding repeating itself after five poles. The same resultant voltage would be obtained from a two-pole machine, each pole having five times the flux of one pole in the ten-pole machine, and five times as many slots per pole and phase as the original ten-pole machine. Assuming approximately one slot per pole and phase in the ten-pole machine, we would have five slots per pole and phase in the equivalent machine. The winding factor f_w for one slot per pole and phase is 1, for five slots per pole and phase is 0.958; hence the voltage in the machine with a fractional pitch will be only 0.958 the voltage of a machine of the same number of slots but having a full number of slots per pole and phase.

(To be continued.)

FIRE PREVENTION IN ELECTRICAL STATIONS*

By H. L. Gannett.

It is recognized that the fire hazards of the electrical industry have been greatly reduced in the last two decades. Old methods of construction wherein more or less wood and other combustibles entered into structure of buildings, switchboards and other electrical equipment, have fallen by the wayside in the marvelous advancement of electrical development. Along with this advancement has come a high degree of efficient housekeeping. "A place for everything and everything in its place" is the slogan of an "up to the minute" station operator.

The mere installation of fire-protection appliances does not thereby furnish an assurance of safety. They must be regularly inspected and cared for. The persons employed where they are placed should be instructed in their use, and where circumstances warrant, fire companies should be organized. The officers should be selected from among those who are ordinarily in authority, who have mechanical knowledge and whose duties insure their presence on the property. Each member of the fire company should be carefully instructed in the handling of the entire fire-fighting equipment. It is needless to say that cool-headed men should be chosen for fire service. Drills should be held at regular intervals and at other times to test the punctuality of the service. Attention should be given to fire service at night.

Having fire protection naturally includes the removing of conditions conducive to the occurrence of fire. This phase of the subject is of infinite variety and in the limited scope of this paper can be but briefly discussed. Neatness and order, coupled with prompt removal of castoff combustible material, can be put down as a rule of great value, and one which should be strictly adhered to. The removal of conditions which cause fire or which would cause its ready spread after having started is greatly to be desired. With our knowledge of the embarrassment of the electric light and power companies when an interruption of service occurs, we can readily see that every precaution should be taken to render generating stations, substations, switch houses, etc., as near fireproof as possible. No more combustible material should be used in construction than is absolutely necessary. All outside walls, division walls and partitions should be of fireproof construction. All windows should be of wire glass in standard metal frames; all doors should be of metal, or of wood which is metal-clad. Doors between sections should be standard fire doors. Small inclosed closets and other concealed spaces should be dispensed with as far as possible so that there can be no accumulation of rubbish or unnecessary articles in any part of the station. Dust should not be allowed to accumulate and especially does this apply in boiler rooms and coal quarters.

Storage-battery rooms should be properly ventilated and care should be taken in the wiring for lights and motors to avoid possibility of sparks or flashes.

Stock contained in buildings should be stored compactly, neatly and orderly and in such a manner as to render it as slow burning as possible and less liable to communicate fire from shelf to shelf and room to room.

Hay and excelsior should be removed from packing cases wherever practicable, or, failing in this, they should be isolated and rendered as safe as possible. Gasoline, benzine, benzoin, naphtha, collodion, and like inflammable products should be isolated and handled with care. Where a large quantity of gasoline is kept on hand it should be apart from buildings and stored in an underground tank with an approved pump. Such small quantities as are for daily use should be drawn into and used from an approved safety can only.

Heating appliances used on benches, etc., should have metal or other fire resistives beneath them. Wiring, including switches, should be installed in a safe manner with due regard to surroundings.

Smoking should be prohibited in storerooms, paint rooms and other places where conditions warrant and signs to that effect should be prominently posted and rigidly enforced. The use of wooden lockers and cupboards should be discouraged as they furnish a hazard proportionate to the number of persons using them.

The use of extension cords should be discouraged except where absolutely necessary. Lighted lamps should never be placed on or near combustible or inflammable material. Self-closing cans should be provided for sweepings, rubbish, oily rags, waste, etc. These cans should have metal legs to raise them slightly above the floor.

In the extinguishing of electrical fires there is large opportunity for the display of good judgment and prompt action. The element of time is exceedingly important. The operator should observe whether conditions warrant the cutting off of current from the affected part before the fire is attacked. His knowledge of the apparatus under his charge should be such as to guide him promptly. Personal safety would discourage the use of Babcock or hose-line streams on apparatus in operation, or live current-carrying conductors.

Sand and powdered bicarbonate of soda have been found to have some merit as extinguishing agents in certain kinds of electrical fires, but their use is limited.

Where sand is provided for fire-extinguishing purposes it should be carefully sifted through a sieve of window screen of fourteen mesh to remove larger particles, especially scraps of metal. It should be kept in a clean and dry condition and should not be used where there is a liability of its getting into the bearings of moving parts.

In tests recently made in extinguishing oil fires, wet sawdust impregnated with sal ammoniac has been found to have considerable merit.

Carbon tetrachloride has shown up well as an extinguishing fluid and has the advantage of being a nonconductor to a high degree, which is a very valuable attribute. In modern plants the liability of structural fires is vastly less than the liability of the occurrence of fire in apparatus, and much of this apparatus is so constructed that in case of fire occurring in the interior it is very difficult or impossible to use an extinguishing agent with success. Then, again, many fires on apparatus and conductors flash and quickly burn out, affording no time nor necessity for action.

It is impossible within the scope of this brief treatment of the subject to cover the entire field of operations; the operator must be depended upon to exercise his good judgment, which, in practically all cases, should be sufficient to master the situation.

Conditions which favor the loss of property by fire should be eliminated. The possibility of fire should always be borne in mind.

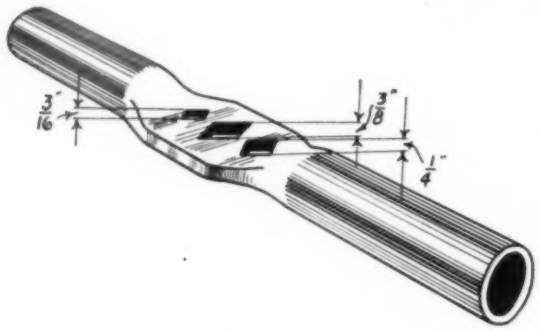
*From recent copy of *Safety Bulletin*, issued by Bureau of Safety, Chicago, Ill.

DOLLAR WIRING KINKS

Every reader is invited to contribute to this page. It does not matter how few words are used to explain a "Dollar Wiring Kink," provided the idea is made clear; if a diagram is necessary, a rough pencil drawing will serve. The idea itself must, of course, be new and bright. A dollar will be sent to the contributor upon publication.

Handy Home-Made Tap Wrench.

The accompanying sketch shows a handy tap wrench that can be quickly made in an emergency while a new wrench is being shipped. It is made from one-half-inch



Home-Made Tap Wrench.

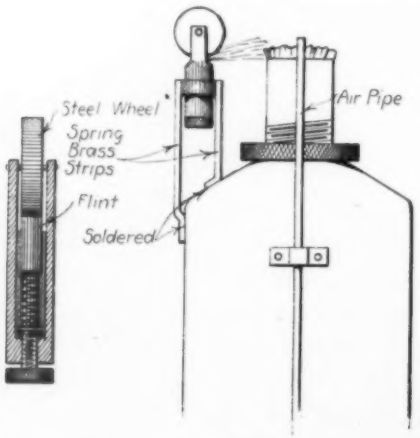
gas pipe 12 inches long. In the middle a portion about two inches long is hammered flat. Three square holes are made in this part by first drilling and then filing square. This makes a good round-handled tool. J. McIntyre.

Reaming Holes in Junction Boxes, Etc.

Arthur Assman's reaming kink in the July 29 issue called for the use of a round file as an efficient tool for general reaming work. I believe that greater satisfaction can be achieved by using the ordinary steel tapered fixture and the larger size conduit reamers. The objection I have found to the file is that it breaks quite easily when used in that way and the steel tapered reamers will stand the strain, because designed for it. M. J. Moriarty.

Lighting of a Small Torch.

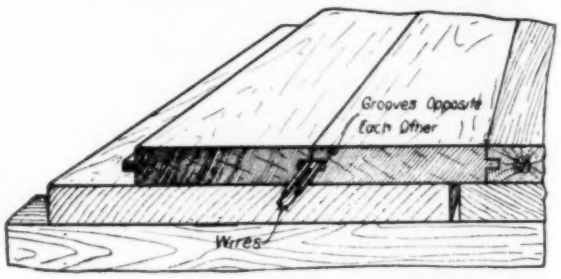
The scheme shown in the accompanying sketch will be found more convenient for lighting a small torch than the use of matches. I remove the lighter from a pocket cigar-lighter and fasten it to the torch by means of spring brass strips soldered in place as shown. The sketch at the side shows the inner construction of the lighter and explains its action. In use a simple twirl of the steel wheel causes the sparks to ignite the wick. This saves looking around for matches and the torch can be lighted quickly even in a draft. W. A. J. Hahn.



Cigar Lighter Applied to Torch.

Runway for Bell Wires in Matched Flooring.

When a new tongue-and-groove wood floor is being laid it is frequently desirable to have the carpenter reverse the last board or two next to the wall along which wires for bells, annunicators, burglar alarms, etc., are to be run.



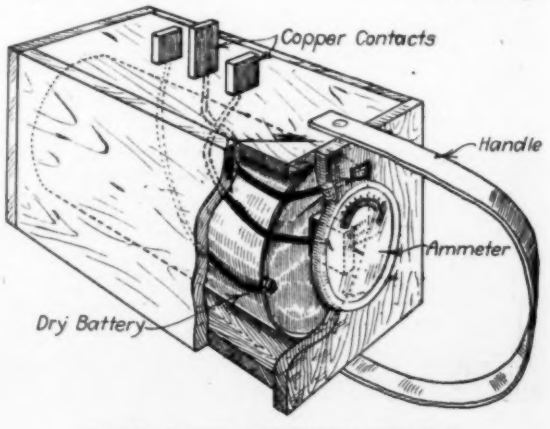
Grooves in Flooring as Bell-Wire Runway.

Thus by placing two grooves together an excellent runway for such wires is formed that protects them and makes it much easier to wire than the usual scheme of running the circuit along baseboards, chair rails, or picture moldings. A hole drilled through the wall opposite each double groove of this kind makes it possible to fish through partitions. W. T. Estlick.

Trouble-Finding and Battery Test Set.

In the shop where I am electrician a large number of portable extension lamps are used. We used to have considerable trouble from the cords becoming "shorted" and grounding and still more trouble in finding the faulty ones. I therefore rigged up the test set shown in the accompanying sketch. I test the cords frequently and find it useful for other purposes also.

The case is made of ½-inch oak with a hole bored in the end just large enough to receive a pocket-size ammeter. One side of the box is screwed on to allow renewal of the dry cell. The carbon pole of the battery connects direct to the case of the ammeter. Between the bottom of the battery and the end of the box is a spiral spring to press the cell against the meter. The copper or brass contacts shown on the top side of the box are arranged to make ready connection with different types of attachment plugs. For this purpose the middle contact and the one at the left are used. If it is desired to test another dry battery, it is connected between the middle and right-hand contacts. R. Hershberger.



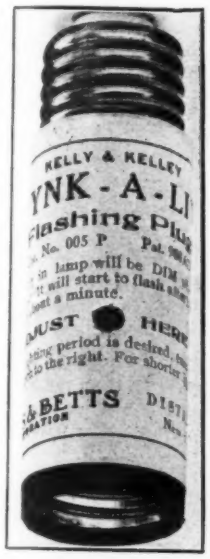
Trouble-Finding and Battery Test Set.

NEW APPLIANCES

A Weekly Review of the Latest Developments and Current Information Respecting Electrical and Kindred Mechanical Appliances

New, Simple Automatic Flashers.

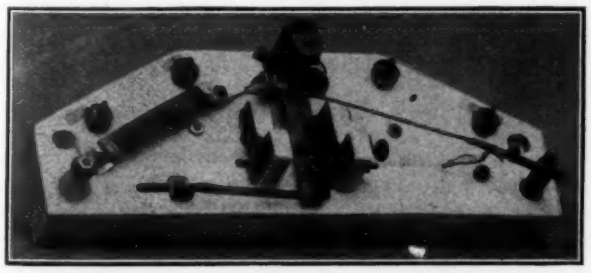
Several new types of automatic flashers of very simple construction have made their appearance on the market and been found to fill a long-felt want. The first one illustrated is an automatic flashing plug, which can be used in any medium-base Edison screw socket and is nearly universal because of its adaptability to use without any adjustment with Mazda lamps ranging from 20 to 60 watts, inclusive, and on any voltage from 50 to 220. The outfit is self-compensating and not affected in any way by temperature changes. It can also be adjusted without removing it from the socket, another advantage it possesses over other flashing plugs. This device is known as the Wynkalite.



New Flashing Plug.

Another new flasher is the new type of Kelley & Kelley Thermo-Wynk flasher, known as the "Tu-Way," because it will operate two circuits alternately. One is closed or lighted while the other is out, the action repeating automatically at regular intervals as long as the entire circuit is closed. The action is positive and it is impossible for the switch blade to leave one contact without going to the other; thus it cannot stick in the center and become inoperative, as is liable to be the case where magnets are used. This device is useful for flashing alternately the two sides of a sign, different groups of colored lamps, illusions where the face lights up first and then the background, and for innumerable other effects which have heretofore been possible only when operated by an expensive motor-driven flasher. Thus this new simple flasher opens up new fields of usefulness where an inexpensive device is called for.

Both these flashers have been approved by the Underwriters' Laboratories. They are being manufactured by Kelley & Kelley, of New York City, and are marketed by the Betts & Betts Corporation, 511-513 West Forty-second Street, New York City. The latter firm has taken over the exclusive distribution of Kelley & Kelley products and has recently secured larger quarters for its rapidly growing business.



Automatic Reversing or Two-Way Flasher.

Ingenious Shade-Holder for C-H Push Sockets.

A shade-holder specially designed for use with Cutler-Hammer push sockets is being marketed by the Plume & Atwood Manufacturing Company, Waterbury, Conn. This holder will accommodate ordinary shades and glassware. The manufacturer has included several features which make the holder an easily installed and attractive device.

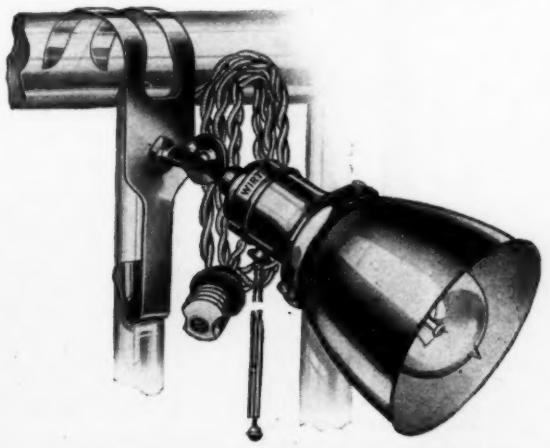
Unlike the ordinary single shade-holder, the new holder comes in two parts, making installation very simple. A clamp collar is slipped over the fixture arm, the socket screwed in place and the body of the holder placed over the socket and secured by screwing the clamp collar to the threaded top of the holder. When the holder is locked in position the clamp collar rests on the cap of the socket, making a very secure fastening which considerably improves the appearance of the completed fixture.

Shade-Holder for Push Sockets.

In addition to the plain design shown in the accompanying illustration, the manufacturer is also supplying these shade-holders in reed and ribbon, and laurel and reed designs. Finishes of these holders are supplied to match the sockets.

New Portable Dim-a-lite Appliance.

One of the newest portable lighting fixtures is the new Dim-a-lite portable. This fixture consists of a special holder attachment, dimming socket, shade, cord and attachment plug. Its construction is such that it may be attached to bed, crib, chair—in fact, almost anywhere—and



Portable Dim-a-lite Used as a Bed Lamp.

it may be easily moved to any particular spot in a moment. The hinge joint is flexible, allowing for a wide range of adjustment.

Pulling the chain gives the usual Dim-a-lite five changes of light. With the full light it can be used for reading, and where a low or dim light is necessary for the nursery or sickroom it is instantly available. All of the changes of light are always at command at any time, to suit any requirement. The new portable should find a ready welcome in hospitals, hotels and all electrically lighted homes. The fixture is regularly finished in brush brass, but any other finish can be furnished.

This new addition to the well known Dim-a-lite line of devices is being manufactured and sold by Wirt Company, Philadelphia, Pa.

Combination Trolley and Ornamental Lighting Posts.

Whenever it has been attempted to provide ornamental lighting on streets where trolley posts are already installed, the difficulty has arisen of adding still more posts to the considerable number already at the curb. A happy solution, in the case where the trolley posts are of steel, is to adapt these for ornamental lighting by installing upon them ornamental brackets, these brackets having one, two or more arms, depending on the number of lights desired on each post.

A view of such a combination post is shown in the accompanying illustration. This is a double-bracket outfit and is typical of a large line manufactured by the King Foundry Company, St. Joseph, Mo., and Chicago, Ill. This particular design includes Novalux lighting fixtures, which are the product of the General Electric Company and are especially designed for the use of 400, 600 or 1,000-candlepower compensator-type Mazda C lamps. The extent of these brackets from center of post to center of lamps is 20 inches and the height of the bracket proper from the base of the acorn ornament to the top of the ventilator above the globe is 38 inches. These brackets are also obtainable arranged for a single light, the single bracket in this case being of similar design but turned so as to overhang either the sidewalk or street alone. In the case of the double bracket shown, it is more customary to have the brackets stand at right angles to the line of the curb instead of parallel therewith, as this gives a more pleasing perspective to the street.

Ornamental Lighting Brackets and Base Applied to Trolley Post.

It is usual when brackets of this type are mounted on the trolley poles to provide also an ornamental base, such as the one shown in the illustration. This is of a design to harmonize with the type of bracket used and, like the bracket, can be easily applied to the post without interfering with the use thereof in any way. As a rule these brackets are fed from underground circuits but they may also be supplied from overhead circuits, in which latter case a special crossarm is placed on top of the pole for this purpose.

Woodrow Electric Washer.

A very simple and rugged type of washing machine is being placed on the market by the Woodrow Manufacturing Company, of Newton, Iowa. This washer has been designed with great care and is the result of long experience in washing-machine construction. The new machine

Woodrow Electric Washing Machine.

possesses a number of distinctive features, of which probably the most important are that it has an easily tilted tub for draining water and that it has a framework made entirely of galvanized iron and all parts of the machine, especially those with which the clothes come in contact are throughly protected against rust; the machine also has an interchangeable disk and dolly supplied with all models of the machine.

The tub is made of the best grade of kiln-dried Louisiana cypress. There are no bolt heads inside of the tub to come in contact with the clothes. The lid or hinged cover of the tub opens backward and not to the side where it would be in the way; this also insures against danger of oil dripping on the clean clothes. When the lid is closed the lining fits tightly around its edge. Draining of the tub is accomplished very easily through the faucet outlet by tilting the tub, which is especially pivoted to the frame for this purpose; this saves lifting and sponging or mopping of the tub. The supporting framework is strong and durable, being entirely rustproof and easily cleaned. One or more side frames are provided which can be easily folded up when not in use so as to make the machine compact; these frames are very convenient for holding wash baskets or rinsing tubs.

The machine has a relatively small number of parts and these are carefully protected both to insure safety to the operator and to prevent the clothes from being torn and also to avoid liability of rust or oil spots. The gearing is mounted on extra long bearings securely fastened to the framework. Very simple lubrication, requiring oil filling only about twice a year, is provided. The control is very simple and has both levers placed on the same side of the machine. A clutch working on a slowly moving shaft makes the control easier and relieves the starting load on the motor.

The wringer is mounted on a post independent of the

tub. This relieves the tub of all strain from this source. The wringer can be easily swung and operated in any position. It can be run in either direction, either by itself or while the washer also is in operation. The wringer is of high quality throughout and is equipped with 12-inch rolls, long coil springs and is thoroughly safeguarded with inclosed gears. White porcelain drip boards are provided on both sides of the wringer, which also has a reversible water board and a quick release on the rolls to take the tension off in an instant in case the clothes should become bunched.

The washing tub has a telescoping post upon which either the washing disk or dolly can be readily mounted and interchanged in a few moments. The disk is recommended for general washing, but the dolly may be used instead for special purposes. The machine is mounted on easy running castors that are bolted to the shoes so as to prevent dropping out. The drive is a one-sixth horsepower inclosed special washing-machine motor, which has ample power to take care of a heavy load on both washer and wringer at the same time. These washers are also made with a pulley for operating by means of belting from any shaft or power source.

Wakefield Combination Globe Holder and Socket Unit.

For use with pendent chain or stem fixtures the F. W. Wakefield Brass Company, Vermilion, O., is providing a special type of holder for the globes or reflectors used with such units. In the illustrations herewith are shown two of these holders, one without the ventilating cover and the other provided with it. These holders are made in sizes from four to eight inches in diameter and in all cases include a porcelain lamp receptacle, either of the regular screw base or mogul base types. This feature is especially important because fire-insurance inspectors will not pass the use of fiber-lined sockets for lamps larger than 100 watts. These holders are provided with ample ventilation and in the case of those equipped with regular base receptacles the heated air is arranged so as to escape without even coming in contact with the sides and top of the receptacle where the wire connections are made.

Globe Holder and Socket Unit, With and Without Ventilating Cover.

Outdoor Substation of Low Cost.

The accompanying illustration shows an interesting high-tension installation, comprising a 22,000/2,300/4,000-volt, 25-cycle, 900-kilovolt-ampere, outdoor substation as a center unit, combined with a switching installation on either side.

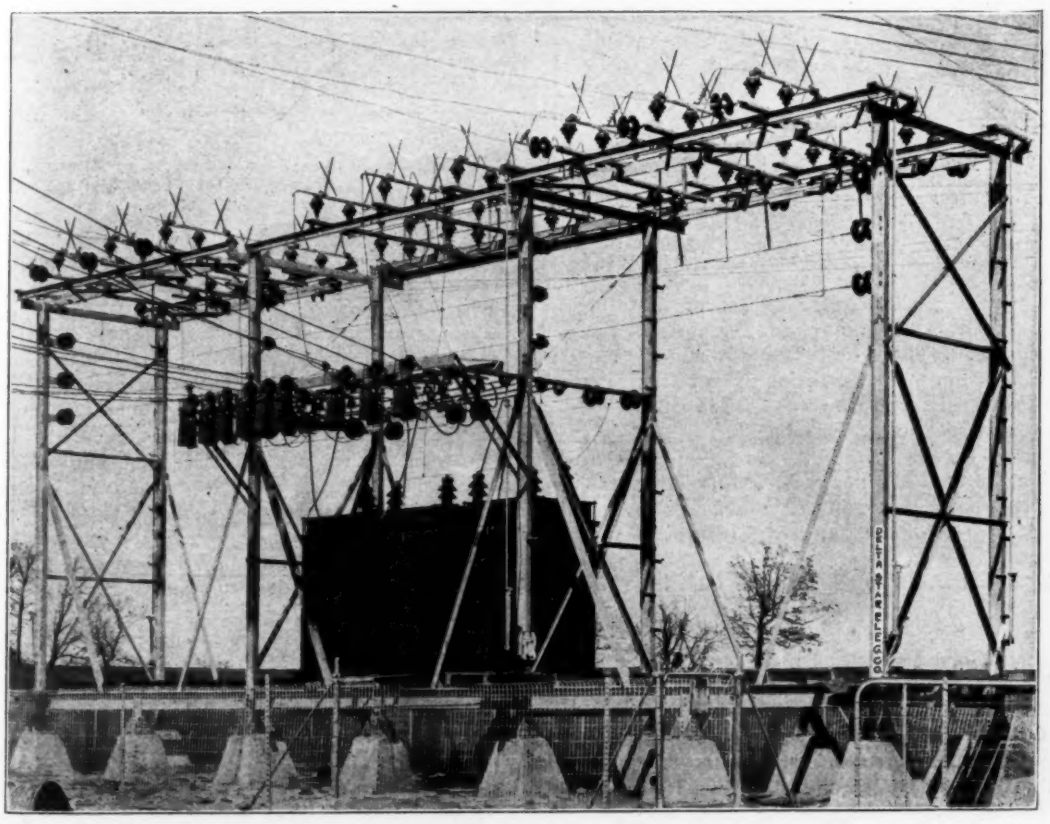
The 22,000-volt side of the substation or center unit is equipped with three-pole, air-break switches, choke coils, chemical fuses and graded-resistance high-speed sphere-gap lightning arresters. The 2,300/4,000-volt secondary circuits are equipped with disconnecting switches, chemical fuses, choke coils and arresters.

The cost of this center or substation unit is shown in the following tabulation:

Material cost per K.V.A.	$4.33
Labor* cost per K. V. A.	.55
Total cost per K.V.A.	4.88

*This cost includes hauling of transformers. Owing to the distance and bad condition of roads, this cost was approximately one-half of the total labor cost.

All steel and malleable-iron parts of the tower, switch and control equipment are hot-galvanized. The two steel-frame end units are so designed that they can later be used to support additional transformers. With an increase in capacity the kilovolt-ampere cost of the complete equipment will be correspondingly less than the cost of the initial or center unit.



Combination Outdoor Substation and Switching Equipment of Low Cost.

The steel towers, all high-tension equipment and low-tension switches, choke coils and fuses are of the standard type supplied by the Delta-Star Electric Company, 2437 Fulton Street, Chicago, Ill. The low-tension arresters are of the Garton-Daniels type and the transformers made by the Westinghouse Electric & Manufacturing Company.

Improved Design of Induction Feeder-Voltage Regulator.

After a considerable amount of engineering and experimental work with a view to improving the electrical performance and mechanical details, the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has placed on the market the improved design of feeder-voltage regulator illustrated herewith. This is a single-phase induction regulator, known as type C, for 2,300 volts, 60 cycles, 10 per cent regulation, and it is standardized in all ratings from 5.75 to 69 kilovolt-amperes. The refinements secured in this new design have increased the reliability of the regulator in service and have simplified and decreased the expense of the wiring necessary for installing accessories for automatic operation in addition to improving the electrical efficiency. Figs. 1 and 2 show, respectively, the regulator complete and also removed from its tank.

The rotor is wound with form-wound coils and constitutes the primary element. The short-circuiting coils in the rotor are formed from a large number of turns of relatively small size enamelled copper wire, thus reducing the watts lost in these windings without decreasing the neutralizing effect for which they are provided. The stator core with the secondary windings in place is shown in the lower part of Fig 2 and separately in Fig. 3. This core is of the frameless construction so largely used in the construction of induction motors. With this form of construction the cross section of the stator core is increased without a corresponding increase in size of other parts and of floor space, resulting in a decrease of iron loss and exciting current. Furthermore, the insulating oil, in which the regulator is immersed in the tank, comes in direct contact with all surfaces of the stator core with more efficient cooling effect.

In a regulator, the insulation of windings is of vital importance because of the severe conditions of operation. The coils for both primary and secondary are therefore carefully insulated and impregnated, and are assembled in open slots. They are held by fiber wedges driven in small grooves at the top edges of the slots. Heavily insulated steel bracing rings are assembled around the exposed ends of the stator coils at both ends of the core. These rings are bound to the coils with cord, and greatly stiffen the coils against distortion from mechanical shock caused by current surges in the feeder during periods of line disturbance or short-circuit. This feature is an important one, increasing the protection to the coil insulation and the factor of safety of the regulator in service.

An electrically controlled switch or auxiliary relay for the operating motor, formerly mounted separately from the regulator, is now mounted directly on the regulator top cover and includes the limit switch. This arrangement cuts down the number of wires required in the control circuit for automatic operation, and simplifies installation and lessens its expense. The chance of failure in the control circuit is correspondingly lessened as well, and inspection of the wiring is made easy.

The operating motor is provided with a quick-acting magnetic brake as heretofore, but the operating mechanism has been changed, so that the regulator now requires only 10 seconds for the complete range of travel from maximum buck to maximum boost, or 20 per cent regulation.

The regulator is made as a unit and may be quickly removed from the tank by simply unbolting the top cover, thus making inspection and repairs comparatively simple. The tank is formed from sheet-steel walls with oxy-acetylene-welded seams and with top and bottom flanges cast on to the walls. This type of tank is the same as that used with Westinghouse oil-insulated self-cooled transformers. It is strong without undue weight, and free from oil leakage. The radiation quality is necessarily very high.

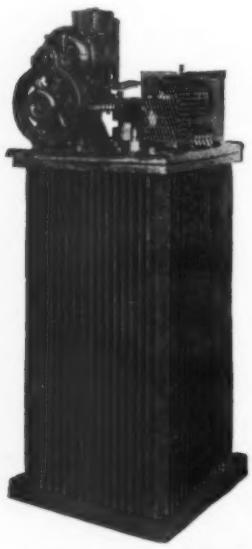


Fig. 1.—New Design of Westinghouse Induction Feeder-Voltage Regulator—Completely Equipped for Service.

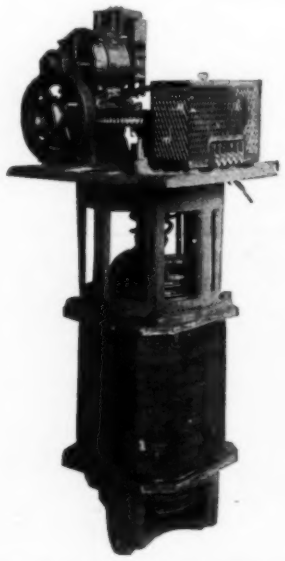


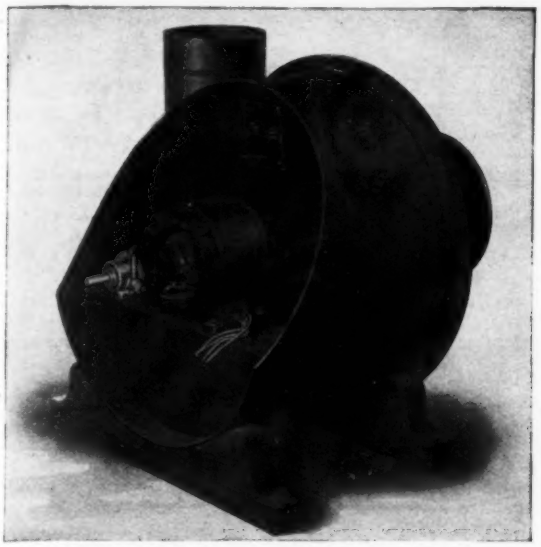
Fig. 2.—Feeder-Voltage Regulator With Oil Tank Removed, Showing Internal Arrangement.

Fig. 3.—Enlarged View of Stator Coil and Core for Feeder-Voltage Regulator.

Spencer Steel Motor-Driven Organ Blower.

It is not so long ago that organs were pumped by hand. As they were then operated on from two to three-inch water-column pressure, such a method served the purpose to a fair degree. Now, however, as high as 20,000 cubic feet of air per minute is used, at pressures from 4 to 40 inches water column, making hand pumping out of the question.

For the past 25 years the Organ Power Company, Hartford, Conn., has been devoting its attention to the solution of organ-blowing problems. The blowers of this company are the result of long years of development under actual working conditions. The pioneer work included experiments with rotary and reciprocating water motors. Electric blowers, however, have now been adopted as standard. These electric blowers were first of wood-box construction, then of wood and metal, and finally of cylindrical metal construction. The open-type cylindrical steel "Obrgoblo" illustrated is the result of these developments and is acknowledged to represent the highest development of the



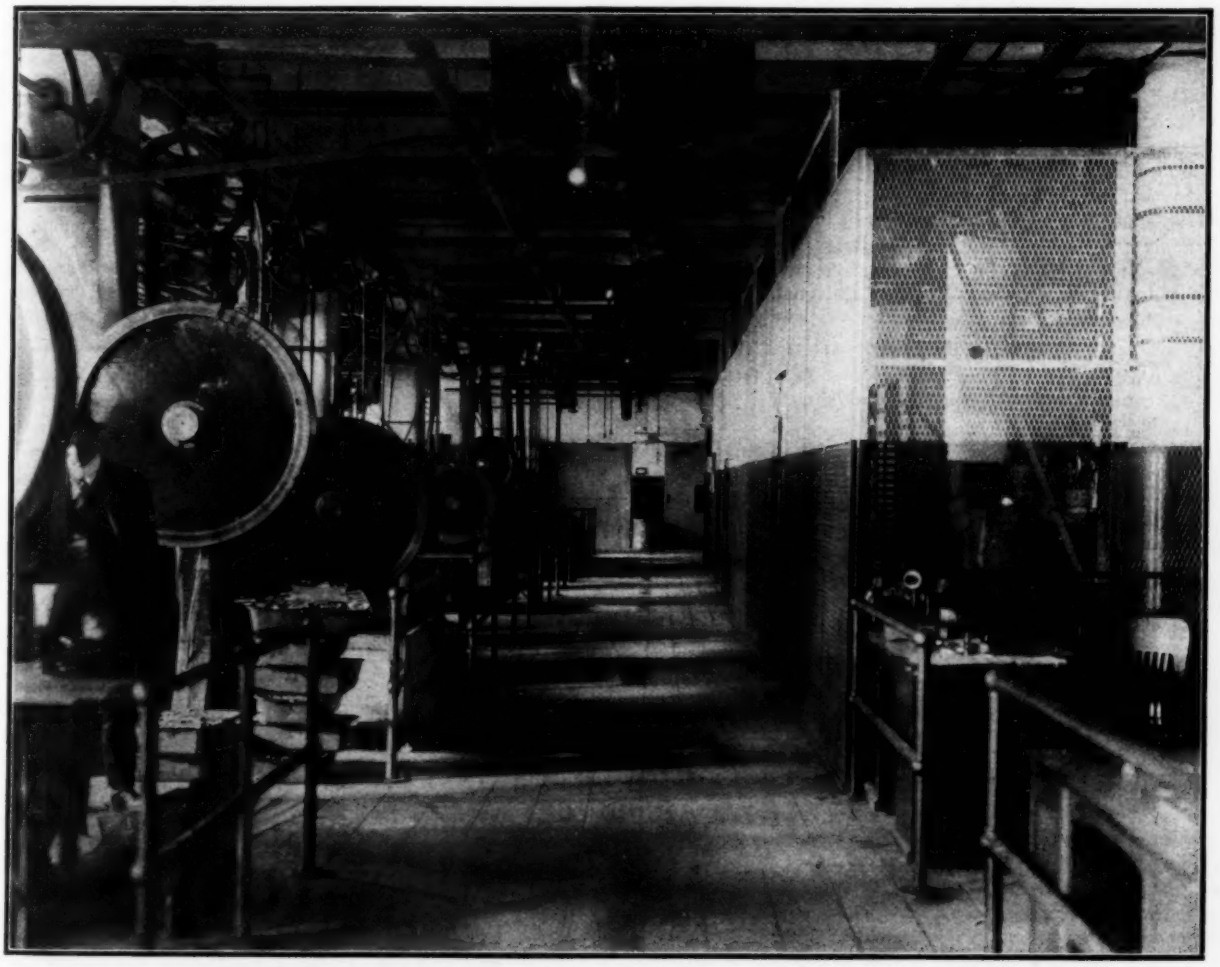
The Orgoblo—A Motor-Driven Organ Blower.

organ-blowing art. Orgoblos received the highest award at Panama-Pacific International Exposition, San Francisco.

Alternating and direct-current motors varying in capacity from 2 to 15 horsepower, made by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., are employed to operate the blowers made by this company. The motors are direct-connected to the fan of the blowers and possess characteristics which especially suit them for blowing work.

In the Spencer steel Orgoblo the air has a continuous passage throughout the machine, thereby avoiding losses incident to stopping and starting the air between stages, and is said to be the only one in which the loss by fan side leakage has been entirely overcome. A two-stage or compound blower is standard. To meet the demand for a low-priced blower a special fan type is made, which runs at a high speed, but is not recommended for use unless it can be placed some distance away from the organ, so that the noise will not be heard.

A great many multi-pressure blowers are also made having several discharge openings. For instance, passing the low pressure through two stages, the intermediate through four stages, and the high pressure through six stages, thereby only consuming enough power to put the wind up to the pressure required instead of putting all the wind up to the highest pressure and dropping it back with pressure regulators, as was formerly done. Thus considerable economy is effected by this arrangement.



View in One of the Punch-Press Departments of the Western Electric Company, Incorporated.

This illustration shows some of the means employed at the big Hawthorne (Ill.) telephone plant of the Western Electric Company, Incorporated, to make the departments safe. Good lighting and convenient, unobstructed arrangement solve only part of the problem. A few of the many other things taken into consideration are observable in the illustration. The flywheels of the presses are made solid, eliminating all chances of such accidents as occur in some factories when workmen stumble into spoked wheels. Railings separate the presses from the aisles, so that porters and other employees passing through the department cannot come in contact with the moving machinery. The driving motors are mounted on the ceiling and are controlled through hanging chains, so that all danger from them is eliminated. At the rear, to the right of the freight elevator door, one-half of the heavy steel double firedoor is visible. Each section of the buildings is separated from adjoining sections by fireproof walls containing these large double doors, in addition to one or more single doors, also of steel.

INDUSTRY ACTIVITIES

Landers, Frary & Clark, New Britain, Conn., have issued a revised price list under date of September 15 which applies to their line of Universal electric home needs. A new catalog of electric appliances is now being distributed.

The Lincoln Electric Company, Cleveland, O., has issued a 48-page catalog on its two and three-phase alternating-current induction motors. Descriptions of the motors are given and many of their applications are described and illustrated.

Manufacturers' Appraisal Company, Commercial Bank Building, Cleveland, O., has issued a booklet on "Scientific Appraisals," which covers public utilities, factories, etc. Copies will be furnished to those interested on request to the company.

The Edison Storage Battery Supply Company, Orange, N. J., announces the opening of its Los Angeles office on the fourth floor of the San Fernando Building, Fourth and Main Streets. James F. Rogan, who has been acting as local distributor of Edison storage batteries in Los Angeles, will become resident manager. The company also maintains two other offices on the Pacific Coast, one at 206 First Street, San Francisco, in charge of District Manager E. M. Cutting, and another at 65 Columbia Street, Seattle, under F. C. Gibson as resident manager.

New Plan for Testing Meters.—The Public Service Commission of the First District of New York have issued a notice that hereafter all testing of electric meters will be conducted at the electrical laboratory of the Commission, in the interest of obtaining a standard meter-testing basis throughout the city. This work has heretofore been handled by the Department of Water Supply, Gas and Electricity, New York City, which will receive all reports of tests from the Commission. The department also reserves the right to make its own tests at any time and to cancel the agreement with the Commission should it be deemed advisable.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has issued leaflet No. 3,913, which describes and illustrates industrial heating appliances manufactured by the company. A brief description and some of the uses are given of each of the different devices. The company has also issued leaflet No. 1,292, on loom motors with waste-packed bearings; leaflet No. 3,828, on oil-well motors for pumping by means of powers and pull rods: leaflet No. 3,872, on the application of lightning arresters to direct-current street-railway cars, and leaflet No. 3,916, on type C induction feeder-voltage regulators for the automatic regulation of all commercial alternating-current feeder circuits.

The Globe Stove & Range Company, Kokomo, Ind., announces that Globe electric ranges will be installed by the Menteer Realty Company, St. Louis, Mo., in a 36-apartment building to be erected in that city. The model selected was the Globe B-4 range with three top units, elevated oven and top and bottom unit in the oven. Stoves with nickel finish were specified as being more in keeping with the modern finish of the kitchens in which they are to be placed. While much has been said about the installations of electric ranges in apartment houses of western cities, such as Salt Lake City, and eastern cities, such as Boston, the equipment of a large apartment building in one of the central western cities will be regarded as another step in the country-wide use of electric ranges in apartment buildings. Other builders in St. Louis are also considering the installation of electric ranges.

The Trumbull Electric Manufacturing Company, Plainville, Conn., announces the removal of its branch offices in Chicago, Ill., to larger and more convenient quarters at 40 South Clinton Street. The change, which will take place on October 2, will enable W. P. Naser, manager of the branch, to give better and more efficient service to the trade than ever before.

Pleasure Yacht, with Many Electrical Features, Fitted for War Service.—There was recently launched in Philadelphia the first yacht of its kind in the United States. This boat, the *Nedeva II*, was built by E. T. Stotesbury, and is equipped to enter the United States Navy service as a submarine chaser in the event of war, and is also complete in every detail as a pleasure cruiser. The *Nedeva II* is 60 feet in length, has a beam of 10 feet 10 inches, a draft of three feet six inches and a speed of 25 miles per hour. It is equipped with two eight-cylinder, 180-horsepower Sterling gas engines and will have a radius of operation of 1,000 miles. The boat carries a non-recoil six-pounder gun on her forward deck and is also equipped with wireless apparatus. It will cost $30,000 with engine, the electrical equipment alone costing $10,000. As a pleasure yacht the boat is fitted in the most luxurious manner, having a large saloon forward with extension berths. Amidships are the engine room, galley and electric plant. The boat is equipped with an electric range in the galley, an electric hot-water plant and an electric refrigerating plant, in addition to an electric lighting system. In order to give a continuous electric service there has been installed a storage battery of 56 cells, type MV, "Ironclad-Exide" battery, manufactured by the Electric Storage Battery Company, Philadelphia, Pa. Every detail of the boat is designed and fitted with the view of giving the maximum service in case of war, and at the same time not to sacrifice any pleasure facilities.

The Faultless Anchor Company, Fostoria, O., justly prides itself on the extraordinary recent performance of two of its Faultless guy anchors. A new 30-ton steel interurban car of the Toledo, Fostoria & Findlay Railway was derailed and bodily thrown into a ditch adjoining the track near Arcadia, O. The car was replaced on the track in an ingenious manner without a derrick. A large size Faultless anchor with a one-inch strain rod was planted opposite each end of the ditched car on the opposite side of the track therefrom. Heavy block and fall tackle equipped with large steel cables was then connected between the anchor and the end of the interurban opposite; the pull was made by means of another interurban car up the track. By alternating the pull first on one, then on the other, end of the fallen car, it was dragged up to the track. Then a mighty strain was applied and the 30-ton passenger coach was turned over to right side up. The anchors were removed from the ground and showed no sign whatever of the tremendous strain they had been subjected to and which they withstood without slipping. This type of anchor has been on the market less than two years, during which time its excellent qualities have brought it rapidly to the front. Its installation is simple; it is planted deep in the ground when by means of a simple mechanism the large and strong spoon-shaped fins at its lower end are expanded into the solid earth, taking a firm hold and resisting even extraordinary pulls, as is indicated by the tests mentioned.

PERSONAL AND BIOGRAPHICAL

MR. RAY S. QUICK has been appointed as research fellow in the department of electrical engineering of the University of Illinois. Mr. Quick is a graduate of the college of electrical engineering, University of California, class of 1916.

MR. SAMUEL WILSON GREENLAND, who was elected last week to the presidency of the Indiana Electric Light Association, is the general manager of the Fort Wayne & Northern Indiana Traction Company, with headquarters at Fort Wayne, Ind. Mr. Greenland was born April 27, 1879, at Clarion, Pa. He received his general education at the Pennsylvania Military College, Chester, Pa., and his electrical engineering collegiate training at Pennsylvania State College. Since graduation from college, Mr. Greenland has been engaged chiefly in the utility field. He first was associated with the construction department of the American Telephone & Telegraph Company in its Pittsburgh district. He then was engaged for some time in gas, electrical and electric-railway engineering with Robert W. Watson, in Harrisburg, Pa. Subsequently he became the general manager of the Columbus Railway, Light & Power Company, operating a combined gas, electric light and street-railway property at Columbus, Miss. Several years ago he came to Fort Wayne to assume his present duties of

S. W. Greenland.

general management of the extensive properties of the Fort Wayne & Northern Indiana Traction Company. This utility company operates 220 miles of street and interurban railway lines in the city and vicinity of Fort Wayne, also the central electric light and power plant at Fort Wayne and the extensive transmission system that supplies 13 towns in the neighborhood of the city and adjacent to the high-tension circuits of the interurban railway lines. Mr. Greenland is a member of the American Institute of Electrical Engineers and the National Electric Light Association, as well as of the Indiana Association, whose president he has just become, and of other organizations.

MR. ROBERT W. LITTELL has announced his resignation as secretary and treasurer of the Kentucky Electrical Company, of Owensboro, Ky.

MR. WILLIAM MUELLER, for several years identified with the Western Electric Company, Chicago, as manager of the pole department, has become connected with B. J. Carney & Company, of Grinnell, Iowa, as Chicago manager and will have offices at 1729 McCormick Building. Mr. Mueller has made an enviable reputation in the cedar-pole business and is particularly fitted to handle the increasing volume of business which the Carney company is enjoying in the Chicago territory.

MR. D. C. GREEN, for the past year and a half manager of the Salt Lake division of the Utah Power & Light Company, has resigned to become general manager of the Fort Smith (Ark.) Light & Traction Company, operated by H. M. Byllesby & Company, of Chicago. This property furnishes electric, gas and street-railway service in Fort Smith, and operates an interurban line between Fort Smith and Van Buren. Before taking his position with the Utah Power & Light Company, Mr. Green had been connected with the Byllesby company for several years at San Diego, Cal.; Albany, Ore.; Marshfield, Ore, and Everett, Wash. He was graduated from Purdue University in 1908. Announcement has been made that for the present the duties of manager of the Salt Lake division of the Utah Power & Light Company will be combined with those of the general sales manager of the company, and that MR W. R. PUTNAM, the present general sales manager, will assume the responsibilities of the combined position.

MR. ROBERT J. GASKILL, who was elected president of the International Association of Municipal Electricians at its recent annual convention at Baltimore, is superintendent of fire-alarm and police telegraph of the city of Fort Wayne, Ind. Mr. Gaskill is a fine type of self-made man, having received his early training and developed his technical education under severe difficulties. His first practical electrical work was with some independent telephone companies. Then for several years he was assistant foreman of construction for the Central Union Telephone Company, being engaged in telephone line construction principally in northern Indiana and Ohio. In 1906 he became assistant to the superintendent of fire-alarm and police telegraph of Fort Wayne, receiving his present appointment on the death of the former incumbent. He is the inventor of an improvement in fire-alarm boxes which has been patented. Mr. Gaskill has for many years been very active in the affairs of the International Association of Municipal Electricians, of which he was vice-president for two years and chairman of the Executive Committee for one year. His election to the presidency is a worthy recognition of his services to the organization.

MR. OSCAR C. TURNER, Past Jupiter Eight of the Jovian Order, has accepted a position as western manager for John H. Parker & Son, manufacturers of porcelain products, and has established headquarters in Chicago, Ill. His temporary address is La Salle Hotel.

O. C. Turner.

Mr. Turner's return to the electrical industry, from which he has been absent for a short period since his withdrawal from the Turner Electric Supply Company, Birmingham, Ala., will be welcomed with pleasure by the electrical fraternity unified as his friends by his genial and capable personality, which will undoubtedly win for him a host of friends in his new field.

OBITUARY.

MR. MATHIAS PFATISCHER, consulting engineer of the Electro Dynamic Company, Bayonne, N. J., died in Roselle, N. J., September 10. Mr. Pfatischer was an electrical engineer and inventor. He invented the electric steering gear, with which several Russian battleships and one or two of the United States cruisers are equipped. He designed and engineered the entire electrical equipment on two of the first large steamships built in the United States, which included electric ship telegraph, electric propeller-shaft revolution indicators and rudder indicators. He also originated running wires in conduit aboard steamships. Mr. Pfatischer was instrumental in developing a single-phase alternating-current motor about 18 years ago which has had very good results in the electrical field. In 1904 he invented the interpole variable-speed motor which revolutionized the design of direct-current motors. In 1908 he was awarded the John Scott Medal from the Franklin Institute of Philadelphia for this invention. Mr. Pfatischer was a member of the American Institute of Electrical Engineers, Electric Power Club, the Technical Society of New York, Franklin Institute, and the Elektrotechnische Verein Society of Berlin, Germany. He leaves a widow and one daughter.

CURRENT ELECTRICAL NEWS

Weekly Record of Construction Activities

EASTERN STATES.

DOVER, N. H.——The City Council has been petitioned for extensions to the street-lighting system on Dewey and Linden Streets.

SWANTON, VT.—The Town Trustees have been authorized to issue bonds to the amount of $17,000 to pay for the development of the power plant at Highgate.

BONDSVILLE, MASS.—The Boston Duck Company has begun the erection of a new power plant in connection with its factory here.

CHARLTON, MASS.—The Webster & Southbridge Gas & Electric Company plans to construct a high-tension transmission line in Charlton to connect its Oxford and Southbridge lines. The line will be built on private right of way if arrangements can be made with land owners.

MELROSE, MASS.—Construction has been begun on a transformer and lightning-arrester station to receive an overhead high-tension line to be built between Malden and Salem. The station will be of brick and will cost about $3,000. It is stated that the new tie line will be in operation by midwinter. Charles H. Tenney & Company, Boston, are the engineering managers.

NEWBURYPORT, MASS.—The Newburyport Gas & Electric Company will run a transmission line across the Merrimack River to Ring's Island, there to connect with the system of the Amesbury (Mass.) Electric Light Company. Two transformers will be placed on the north side of the power station on Fiberloid Wharf.

NORTH ADAMS, MASS.—Power lines of the New England Power Company will be built over the mountains from the Deerfield River generating plants to supply Beaver Mills with about 1,500 horsepower.

PITTSFIELD, MASS.—The Pittsfield Electric Company has applied to the Massachusetts Gas & Electric Light Commission for authority to extend its lines into the town of Lee.

RAYNHAM, MASS.—The Specialty Nail Company has petitioned the Committee of Public Works of Taunton for electric power and light service in Raynham. Manager Wood of the Taunton municipal plant stated that the service could be installed at a cost of $5,000, and lighting service furnished to the residents of North Raynham.

SALEM, MASS.—The Salem Electric Lighting Company plans to add another turbogenerater at its tidewater station here. This will give a total of 23,000 electric horsepower.

WESTFIELD, MASS.—At a special town meeting an appropriation of $20,000 was made for operating expenses for the municipal lighting department. A committee of three was appointed for the investigation of the affairs of the department.

CUMBERLAND, R. I.—The Blackstone Valley Gas & Electric Company will extend its electric lines on the Sneech Pond, West Wrentham and Sheldonville roads, through Diamond Hill and Arnold's Mills to the state line.

PROVIDENCE, R. I.—The Narragansett Electric Lighting Company will build a three-story brick and steel addition, 48 by 70 feet, to its power plant on Elm Street. Other enlargements of the plant are planned, the company having secured a tract of land near the present plant.

WESTERLY, R. I.—The Westerly Light & Power Company has filed with the Public Utilities Commission a reduction in its price for residence service from 14 to 12 cents a kilowatt-hour. A complaint relative to the minimum charge was filed with the board by consumers.

WOONSOCKET, R. I.—A 13,000-volt transmission line is projected by the Blackstone Valley Gas & Electric Company to North Attleboro, Mass., to serve as an added source of supply to the Union Light & Power Company, Franklin, Mass.

GREENWICH, CONN.—The New York, New Haven & Hartford Railroad Company plans to erect a large switch plant here with a tower to contain 32 electric and 16 mechanical machines. Another large addition to the company's plant will be an electric switch and signal system for the New York & Connecting Railroad. This is being designed in collaboration with the Pennsylvania Railway's engineering force. Installation will be begun soon, to be ready for use in January, 1917.

NORWALK, CONN.—The voters of the community have decided against contracting with the United Electric Light & Water Company of New Haven for the supply of electricity in place of operating the local municipal plant.

BUFFALO, N. Y.—The City Council has received a petition from the North Main Street Business Men's Association asking for the installation of magnetite lamps in Main Street.

DANSVILLE, N. Y.—The Dansville Gas & Electric Company will build an addition to its power plant in which a 250-horsepower boiler will be installed.

NEW YORK, N. Y.—The Kings County Lighting Company has obtained the authorization of the Public Service Commission to issue $675,000 worth of additional bonds. The money derived from a sale will be used as follows: For improvements, $472,954.27; for repayment of money expended from income and to be used to offset depreciation of property, $134,545.43.

SYRACUSE, N. Y.—The Hotaling-Warner Company will erect an addition to its plant, costing $7,000, which will be used for power house purposes. Plans for the building have been prepared by Russell & King, of this city, and Dawson Brothers, also of this city, have the construction contract.

BUTLER, N. J.—The Common Council is planning the erection of an additional machinery building at the municipal electric-lighting plant.

CAMDEN, N. J.—The Camden County Almshouse, Blackwood, has had plans prepared for a new power plant.

FLORHAM, N. J.—The City Council has granted the town of Madison a franchise to furnish electric service here.

FREEHOLD, N. J.—The Town Commissioners have passed an ordinance granting the Monmouth Lighting Company a 30-year franchise to operate in this city.

JERSEY CITY, N. J.—Property owners along lower Broadway will negotiate with the city for the installation of a whiteway system.

NEWARK, N. J.—The Public Service Electric Company will build a new one-story screen house at its Point-No-Point power plant.

NEWARK, N. J.—The Board of Freeholders is planning for the installation of individual electric motors for operation at the laundry plant of Overbrook Hospital. The estimated cost of equipment is about $8,000.

NEWARK, N. J.—The Federation of Local Improvement Associations will obtain data regarding the installation of a municipal electric-lighting plant in connection with a proposed garbage disposal plant. Edward J. Macksey, Roseville Improvement Association, is chairman of the committee.

NEWTON, N. J.—The Town Committee is arranging for an appropriation of $8,000 for electric street lighting, to supersede the gas system recently installed.

SOUTH ORANGE, N. J.—The Public Service Electric Company has commenced the installation of an underground conduit system in Academy Street.

TRENTON, N. J.—The City Commission has had plans prepared for a new municipal electrical building by W. P. Endebrock, architect.

ALDAN, PA.—The Delaware County Electric Company has been granted permission to install and operate a street-lighting system here.

ASHLAND, PA.—The Eastern Pennsylvania Light, Heat & Power Company is planning to make extensions to its transmission lines.

BRISTOL, PA.—Warner J. Steel will build a new power house at his local manufacturing plant.

CHESTER, PA.—The Beacon Light Company and Southern Pennsylvania Traction Company will make the joint installation of a new pole line in the business district. The poles will be iron, of ornamental design.

CROMBY, PA.—It is reported that an electric power plant costing $500,000 will be erected here by the Philadelphia Suburban Gas & Electric Company to supply the cities of Pottstown, Phoenixville and West Chester, the plants at these places to be used as auxiliary stations.

GLENFIELD, PA.—The Public Service Commission has granted the Alleghany County Light Company permission to build a new pole line and install a local system.

HIGH SPIRE, PA.—The Public Service Commission has granted the Harrisburg Light & Power Company permission to install and operate a local street- lighting system.

MARCUS HOOK, PA.—The Beacon Light Company, of Chester, has been granted permission to install and operate a local street-lighting system.

PHILADELPHIA, PA.—Directors of the City of Mercy Hospital have had plans prepared for a new power plant by E. F. Durang & Son, architects.

PHILADELPHIA, PA.—The United Electric Construction Company has been awarded the contract for the electrical work in connection with the erection of a new manufacturing plant for S. B. & B. W. Fleisher.

PITTSBURGH, PA.—The McDonald & Burgettstown Street Railway Company has been incorporated with a capital of $100,000 by R. L. Henderson, of Pittsburgh, and others to construct and operate a 15-mile trolley line in Washington county.

RIDLEY PARK, PA.—The Beacon Light Company, of Chester, has applied to the Public Service Commission for permission for the Borough Council to award a five-year street-lighting contract to the company.

READING, PA.—The Reading Transit & Light Company will erect a transmission line to Kutztown.

ST. CLAIR, PA.—The Schuylkill Electric Railways Company will build a new power station near St. Clair.

HYATTSVILLE, MD.—The local electric-lighting franchise will expire soon and before submitting the question to the voters a request will be made to the Potomac Electric Light Company to make improvements.

NORTH CENTRAL STATES.

BUCYRUS, O.—The Bucyrus Electric Light & Power Company has awarded the contract for the erection of its new power house to George Hicks, of South Charleston.

CLEVELAND, O.—To provide immediate facilities for taking on 7,000 more municipal light plant patrons, W. E. Davis, Commissioner of Light and Heat, will recommend to the City Council that an ordinance be passed authorizing the expenditure of $200,000 for the purchase of a 2,000-kilowatt generator and other necessary equipment. The Commissioner has obtained an option on a generator that has been in use at Memphis, Tenn.

COSHOCTON, O.—Work is nearly completed on the new building which is to accommodate the Ohio Service Company's

new power plant here. The new building will house a 5,000-kilowatt turbogenerator and auxiliary equipment.

CINCINNATI, O.—The building committee of the Y. M. C. A. has let to the Ohio Building & Construction Company, of Cincinnati, the contract for the construction of its new building, costing $330,000. A separate power building will be constructed, and the main building will be provided with all of the usual electric devices, including elevators, ventilating fans, etc.

LONDON, O.—Bonds to the amount of $25,000 will be issued by the city for the purpose of financing improvements and extensions to the electric-light plant. The abandonment of the plant was contemplated if the people refused to sanction the improvements, but it is believed that the plant will show a profit if properly modernized.

MASSILLON, O.—Bids will be called for shortly for the installation of a boulevard side-lighting system for the downtown streets. The City Council has authorized the improvement. Iron posts surmounted by tungsten lamps will be used. Bids will also be called for on the contract for furnishing current for street lighting. The cost of installation of the new lights will be paid for by a 40-per-cent assessment on property owners and the remainder by the city.

MEDINA, O.—The Ohio Gas & Electric Company has purchased the local electric plant for $51,700, and is said to be planning to make considerable improvements for the purpose of increasing the business handled.

MIDDLETON, O.—A high-tension line to transmit energy from the lines of the Union Gas & Electric Company to the Ohio Gas & Electric Company's distributing system in this city will be constructed by the latter company at a cost of $90,000. The Ohio Gas & Electric Company has decided to discontinue the operation of its local power plant, and will obtain energy from the Cincinnati company.

SPRINGFIELD, O.—Electrical equipment for the city garage, now under construction, will be installed by the Crain-Desormoux Company, of this city.

YOUNGSTOWN, O.—Announcement has been made by the Mahoning & Shenango Railway & Light Company that it will expend approximately $250,000 for the construction of a new power transmission line from its 40,000-horsepower generating station at Lowellville to Masury for distribution, and thence through the Sharon territory. The new line will be constructed entirely over private right of way and work will start at once. The Lowellville power plant was erected recently at a cost of approximately $2,000,000 and district power demands are said already to have nearly taxed its capacity. Further plant extensions are expected soon.

MUNCIE, IND.—The Muncie Electric Light Company has received a bid of $36,690 and another of $21,500 for its plant here from George W. Wheeler, of New York City, and John Stockdal, of Chicago. The city has been negotiating for the purchase of the plant for a consideration of $15,000.

DEKALB, ILL.—The DeKalb Electric Company is planning to make additions to its power plant.

HANOVER, ILL.—The Interstate Light & Power Company, of Galena, has been granted a franchise to furnish electric service here.

HARDIN, ILL.—Ground has been broken for the new electric-lighting plant to be erected here. The plant will cost about $6,000.

MARENGO, ILL.—Plans are being made for the completion of the proposed Marengo-Harvard electric railway. Right of way has been secured and present plans point to the completion of the road in the near future.

MANISTEE, MICH.—Preparations have been begun by the Consumers Power Company, of Jackson, for the construction of a dam on the Manistee River, about 30 miles from this city. The development is estimated to increase the company's capacity about 22,000 horsepower and the energy will probably be distributed over a high-tension line to the company's plant at Croton and thence to Grand Rapids and other cities for consumption.

NEENAH, WIS.—Officials are making plans to install electric power in the municipal waterworks plant to replace steam power.

OCONOMOWOC, WIS.—The City Council will ask for bids for furnishing electrical energy for street lighting.

DATES AHEAD.

American Electrochemical Society. Semi-annual meeting, New York City, September 28-30. Secretary, J. W. Richards, South Bethlehem, Pa.

American Electric Railway Association. Annual convention, Atlantic City, N. J., October 9-13. Secretary, E. B. Burritt, 8 West Fortieth Street, New York City.

Electrical Supply Jobbers' Association. Quarterly meeting, Hotel Statler, Cleveland, O., October 10-12. Secretary, Franklin Overbaugh, 411 South Clinton Street, Chicago, Ill.

New Mexico Electrical Association. Executive meeting, El Paso del Norte Hotel, El Paso, Tex., October 15-17. Secretary pro tem, E. A. Thiele, 112 West Third Street, Roswell, N. M.

New England Secton, N. E. L. A. Annual convention, Pittsfield, Mass., October 17-20. Secretary, O. A. Bursiel, 149 Trenton Street, Boston, Mass.

Jovian Order. Annual convention. Indianapolis, Ind., October 18-20. Secretary, Ell C. Bennett, Syndicate Trust Building, St. Louis, Mo.

Telephone Pioneers of America. Annual meeting, Atlanta, Ga., October 19-20. Secretary, R. H. Starrett, 195 Broadway, New York City.

TWO RIVERS, WIS.—The High Falls Power Company, which was recently granted a franchise to operate here, is completing the erection of its transmission line from Green Bay.

WATERTOWN, WIS.—The Wisconsin Gas & Electric Company, of Kenosha, has announced the proposed extension of its light and power service north of Watertown to the town of Clyman. Several different routes are being considered and the one offering the greatest number of consumers along the route will be chosen. It is proposed to make this a model farm-service line, which will prove the value of electric service to the farmers.

GRANADA, MINN.—Plans are being considered here for securing electric service.

MINNEAPOLIS, MINN.—E. D. Luce, president of the Luce Electric Lines, has announced the proposed extension of the electric line from Hutchinson to Fairmont, Minn.

RED LAKE FALLS, MINN.—The Red River Power Company has been making considerable extensions and improvements to its hydroelectric power plant on Red Lake River.

VIRGINIA, MINN.—Construction has been commenced on an addition to the local power plant of the Great Northern Power Company. General Manager H. J. Underhill has announced that a 3,500-horsepower turbogenerator will be installed and the power plant completely rehabilitated.

ALDEN, IOWA.—Voters here have approved the granting of a franchise to the Iowa Falls (Iowa) Heat, Light & Power Company to extend its transmission lines into this town. W. C. Hakes is superintendent of the Iowa Falls company.

DERBY, IOWA.—The Leon (Iowa) Electric Company, which was recently granted a franchise here, is now constructing transmission lines from this place to Humeston where the line will connect with the lines now supplying energy to Garden Grove and Humeston from Leon power house. The Leon Electric Company has also been granted a franchise at Le Roy and work on the transmission lines and street and house wiring will begin there soon.

DES MOINES, IOWA.—A. H. Newman & Company has been awarded a contract to build an addition to the Des Moines Street Railway Company's power plant on the Des Moines River. The addition will cost about $55,000.

IOWA FALLS, IOWA.—The City Council is planning to install a motor-driven pump at the waterworks plant.

LENOX, IOWA.—At a recent election voters here denied the granting of an electric franchise to David J. Fisher Company of Davenport, the proposition losing by a vote of 134 to 136. What will be done in regard to securing light and power service is a question at the present time.

ROCKWELL CITY, IOWA.—The Federal Light & Power Company, which owns the plants in Sac City and several surrounding towns, has secured the local electric-lighting plant. The company will build a high-tension line from Sac City to Rockwell City and will build lines to Lake City and Lohrville, where electric service will be furnished. The company will retain the services of A. D. Gibson, the present local manager.

CHILLICOTHE, MO.—Plans are being prepared by E. E. Harper, 2404 East Thirtieth Street, Kansas City, Mo., for a local electric-lighting plant and waterworks system.

AUGUSTA, KANS.—An appropriation of $10,000 has been voted for extensions to the local electric-lighting system.

HURON, KANS.—The city will expend $3,000 for building a three-mile high-tension transmission line.

GRANVILLE, N. D.—Messrs. Bacon and Burr are making the installation of an electric-lighting plant here.

HALLIDAY, N. D.—J. F. Wenrick will erect an electric-lighting plant here, machinery for which has already been purchased.

SOUTH CENTRAL STATES.

FRANKLIN, KY.—It has been announced that the client of S. Walton Forgy of Elkton, Ky., in the purchase of the Franklin Electric & Ice Company was the Kentucky Utilities Company, of Lexington, Ky. The company will make improvements in the plant.

HAZARD, KY.—The $200,000 plant of the Kentucky River Power Company, here, C. E. Carlin, contractor, is under construction. L. E. Weisenberger, New York, is resident engineer. This will be a steam plant located adjacent to a mine.

LAGRANGE, KY.—Suit for nearly $500, claimed due for five months' street lighting service, has been begun by the LaGrange Light & Power Company against the city. A $1,000 guarantee fund paid the company by the city is involved in the litigation.

MIDDLESBORO, KY.—Merchants of this city are projecting a white-way system for the business section of Cumberland Avenue.

RICHMOND, KY.—L. B. Herrington and J. E. Greenleaf state that drill tests for the proposed dam and power plant on the Dix River, near Lancaster, Ky., have proved satisfactory and that construction work will begin shortly.

MEMPHIS, TENN.—Sale of the bonds and construction of the municipal light and power plant is to begin at once, according to Leo Goodman, of the City Commission. Frederick W. Ballard, of Cleveland, O., is engineer, and the city has a bond issue of $1,500,000 for the work.

CANTON, OKLA.—O. A. Hunt, of Watonga, is planning the installation of an electric-lighting plant here.

MUSKOGEE, OKLA.—The Muskogee Gas & Electric Compay has signed a contract with the city by the terms of which 417 nitrogen filled lamps will be installed by November 1.

OLUSTEE, OKLA.—It is reported that the City Council will make the installation of an electric-lighting plant.

WOODWARD, OKLA.—Bonds in the sum of $15,000 have been voted for extensions to the electric-lighting and waterworks plant.

DALLAS, TEX.—The Dallas Ice Factory, Light & Power Company has been granted a franchise by the City Commission to lay a fuel-oil pipe-line over the streets to its plant.

DALLAS, TEX.—As a means of deciding the controversy that exists between the City Commission and J. F. Strickland and associates as to what valuation should be placed upon the street railway and electric-lighting properties in the franchise that is to be granted for their consolidation a straw vote of taxpayers of the city will be taken on the proposition during the week beginning September 23. The Commission wishes to place a valuation of $8,000,000 upon the properties, while Mr. Strickland and associates ask that the value be fixed at $8,500,000. If it is shown that a majority of the taxpayers so voting favor the larger valuation and the franchise is granted on that basis the consolidated company agrees to spend $5,000,000 in and around Dallas within the next three years, this expenditure to include the construction of two interurban lines of railway, one to run to Terrell and the other to Denton, and to make a voluntary reduction of the electric-lighting rates to seven cents per kilowatt-hour.

KINGSVILLE, TEX.—The Texas Southern Electric Company will install new

machinery in its electric light and power plant here. The improvements, including the building of a new brick power station, will cost about $50,000. The company has sold the waterworks plant here to the city of Kingsville for $30,000.

MARLIN, TEX.—The Marlin-Temple Interurban Company has begun the building of a bridge across the Brazos River for the interurban electric railway that it is to construct between Marlin and Temple. H. D. Hanna is chief engineer.

SAN ANTONIO, TEX.—The San Antonio, Gonzales & Houston Interurban Company has been reorganized. Steve Holmes of Leesville, Tex., was elected president, succeeding Col. C. C. Godman of Kansas City, Mo., resigned. It is planned to survey a new route for the proposed interurban electric railway that the company is to construct between San Antonio and Houston, a distance of 225 miles. The building of an electric power station is involved in the project.

WESTERN STATES.

THREE FORKS, MONT.—Swearington & McCulloh, engineers, of Great Falls, have completed plants for an electric-lighting system for this city.

ROLLINSVILLE, COLO.—The Colorado Power Company, of Denver, is extending its high-transmission lines to the Rollinsville district. The new line will complete a loop between the Boulder and Idaho Springs districts and will enable the company to use the Idaho Springs power plant in case the Boulder canon plant is disabled. The power company has recently extended its lines from Rowena to Gold Lake, a distance of two miles, to supply energy for equipment at the tungsten mines there.

YUMA, ARIZ.—The City Council has under consideration the matter of municipal ownership of the local electric-lighting plant.

CONNELL, WASH.—The Spokane & Eastern Trust Company of Spokane has purchased the municipal bonds of the Connell water and lighting system, and the city has assumed charge of the plant.

PORT ANGELES, WASH.—The City Council has plans under way for the issuance of bonds in the sum of $22,000 to take up current indebtedness of the light department and provide funds for needed extensions.

JORDAN VALLEY, ORE.—A representative of the Electric Investment Company, of Boise, Idaho, was in this city recently looking over the field with a view to extending his company's power lines from DeLamar here.

LAPINE, ORE.—The Pringle Falls Electric Company, recently incorporated with a capital stock of $500,000, by F. W. Temes, E. L. Clark and A. D. Lee, proposes to supply power in the La Pine district for irrigation and to furnish energy for lighting Pringle Falls.

FRESNO, CAL.—The City Trustees have passed a resolution of intention providing for the installation of an electrolier system on South L Street.

FRESNO, CAL.—The Pacific Light & Power Company is sending men to the big Creek region in preparation for the work of raising the dams at Huntington Lake. It is expected actual construction work will begin shortly.

LOS ANGELES, CAL.—The Board of Supervisors has approved the report of the lighting committee of the Norwalk lighting district recommending a new contract.

LOS ANGELES, CAL.—The City Attorney has been instructed by the City Council to begin proceedings in the Superior Court for the condemnation of a right of way for the construction of electric power lines over certain lots in the Porter Land & Water Company's subdivision.

NOVATO, CAL.—At a recent mass meeting it was decided to extend the electric-lighting system to the outside districts.

OROVILLE, CAL.—The matter of a municipal lighting system was brought up at a recent meeting of the City Trustees.

OROVILLE, CAL.—It is reported that the North Fork power plant of the Great Western Power Company will have, when completed, a capacity of 250,000 horsepower of electrical energy. This power will be transmitted to all parts of Northern California. In addition to its wireless telephone system, which is now being installed, the company is installing a double-wire telephone line from Las Plumas to the big dam. This line will tap all the construction camps of the company as well as the substations. The new plant will be built on the Feather River, near Belden, Plumas County. The water for the generation of electricity will be brought from the great reservoir known as Lake Almanor in Big Meadows in concrete pipes to the North Fork.

SAN FRANCISCO, CAL.—It is reported that committees will be sent to this city from Portland, Ore., and Seattle, Wash., immediately after the new lighting system is completed on Market Street with a view to installing similar systems in the northern cities.

WOODLAND, CAL.—W. G. DeCelle has been elected president and general manager of the Yolo Water & Power Company, and it is announced the company plans to proceed immediately with the active development and improvement of its entire system.

YREKA, CAL.—The California-Oregon Power Company has applied to the State Railroad Commission for an extension of time within which to comply with the state laws concerning the construction of pole lines.

HONOLULU, T. H.—Charles R. Forbes, chairman of the Public Utility Commission, has announced that negotiations are under way for the sale of the Island Electric company of Mauri.

Proposals

ELECTRIC-LIGHTING PLANT.—Bids will be received October 23 by O. M. Tillis, chairman of the Board of Public Works, Havana, Fla., for the construction of an electric-lighting plant and waterworks system.

ELECTRICAL WORK.—Sealed bids will be received September 30 by A. N. Truedson, Hotel Minnesota Company, Detroit, Minn., for the complete electrical work for a four-story fireproof hotel building, including all labor and materials, according to plans and specifications prepared by Architect E. F. Broomhall, Duluth, Minn.

ELECTRIC PASSENGER ELEVATOR.—Sealed proposals will be opened in the office of the Supervising Architect, Treasury Department, Washington, D. C., at 3 p. m., October 18, 1916, for the installation complete of one electric passenger elevator in the United States customhouse, appraiser's stores, and courthouse, Wilmington, N. C., and for three electric elevators in the United States post office at New Haven, Conn., in accordance with the drawings and specification, copies of which may be had at that office in the discretion of the Supervising Architect. James A. Wetmore, Acting Supervising Architect.

ELECTRICAL SUPPLIES.—Bids will be received at the Bureau of Supplies and Accounts, United States Navy Department, Washington, D. C., for furnishing supplies at the following naval stations: Schedule 137, Brooklyn, N. Y., and Mare Island, Cal., two electric bake ovens. Schedule 138, Brooklyn and Mare Island, eight turret-turning motors. Schedule 139, Brooklyn and Mare Island, two each of motor-driven machine tools. Schedule 142, Brooklyn and Mare Isdland, two each of electrically operated dough-mixing machines, ice-cream freezers, food and meat grinders, dishwashing machines and kitchen and cake machines. Schedule 150, Brooklyn, 6,000 feet of telephone cable, and miscellaneous single-conductor wire. Schedule 160, various navy yards, 16 portable electric drills. Bidders desiring to submit proposals should make application immediately for schedules to the Bureau, or to the purchasing office nearest to navy yard where delivery is to be made.

Financial Notes

Youngstown & Suburban Railway Company which will take over the Youngstown & Suburban Railroad Company, recently sold at receiver's sale, has increased its capital stock from $10,000 to $1,500,000. The company will use a part of the new stock in providing for additions to property and placing the road in good condition.

A dividend has been declared upon the stock of the Kansas City Light & Power Company, payable on September 25. The trustees, on October 2, will pay a dividend of $2.50 upon each whole part represented by such certificates to holders of record at the close of business on September 25. The books of the trustees for the tranfer of certificates and for the conversion of fractional scrip into whole parts will be closed at the office of the Commerce Trust Company, Kansas City, from September 25 to October 2.

The Southern California Edison Company has filed amended articles of incorporation, increasing the capital stock from $30,000,000 to $100,000,000. The company now ranks among the largest in California in point of capitalization. Its stock is divided into 1,000,000 shares of the par value of $100 each. Of this amount 40,000 shares are preferred, the remainder being common. The company furnishes gas, power and light to municipal corporations and power to the street-railway system of Los Angeles and to a number of interurban lines.

The business of the Electric Storage Battery Company for the eight months ended August 31, 1916, has by far exceeded that for any similar period in previous years, and new business continues to be received in large volume. The company earned over 8.25 per cent on its $16,249,000 stock outstanding in the fiscal year ended December 31, 1915, or $1,360,747, which up to that time was the best showing, with the exception of one year, which the company had ever made. The current year should set a new record for profits, though the company has felt the effect of increased labor costs.

The Kings County Lighting Company has obtained permission from the New York Public Service Commission to issue additional bonds in the amount of $675,000. This application was granted upon a rehearing of the case decided by the Commission on May 25, 1916, when an order was issued granting the company permission to issue $472,000 in bonds, the Commission holding that the difference between this amount and the total amount asked for representing money which should have been properly credited to depreciation. The company applied for a rehearing on the grounds that the Commission should have granted the entire amount without any condition as to depreciation allowances. The bonds are to be 38-year five-per cent. and must be sold to net the company at least 90 per cent of their face value. Another condition incident to the issue is that $134,545 of the proceeds of the sale shall be credited to depreciation fund.

The Laurentide Power Company, Limited, has sold to Aldred & Company, of New York; Stone & Webster and Chase & Company, of Boston, and McDougall & Cowans, of Montreal, the unsold one-third of $7,500,000 first-mortgage five-per-cent bonds, due 1946. These securities are a closed mortgage on a hydroelectric plant on the St. Maurice River at Grand Mare, with a present capacity of 125,000, and an ultimate output of 180,000 horsepower. Subject to change, the price quoted is 90 and interest, to yield about 5.70. Both in location and equipment the Laurentide

CLOSING BID PRICES FOR ELECTRICAL SECURITIES IN THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

	Sept. 18	Sept. 11
American Telephone & Telegraph (New York)	132¾	133
Commonwealth Edison (Chicago)	142	142¼
Edison Electric Illuminating (Boston)	238	237
Electric Storage Battery, common (Philadelphia)	66	65½
Electric Storage Battery, preferred (Philadelphia)	66	65½
General Electric (New York)	170½	171
Kings County Electric (New York)	130	130
Massachusetts Electric, common (Boston)	5½	7
Massachusetts Electric, preferred stamped (Boston)	36	40
National Carbon, common (Chicago)	185	185
National Carbon, preferred (Chicago)	122	—
New England Telephone (Boston)	128	127⅝
Philadelphia Electric (Philadelphia)	28¾	28⅞
Postal Telegraph-Cable, common (New York)	85¼	84
Postal Telegraph-Cable, preferred (New York)	66½	66½
Western Union (New York)	101½	95½
Westinghouse, common (New York)	63½	61
Westinghouse, preferred (New York)	70	70

Power Company is favorably situated. The St. Maurice River has a steady volume of flow which is further assured by a Government storage dam built near its headwaters. For eight miles above the site of the power house on both sides of the river the company owns the land and water rights in fee, making possible a large storage of water for immediate use. All the equipment is new and modern. The operation of the company is in the hands of the Shawinigan Water & Power Company, which now purchases 25,000 horsepower from Laurentide Power, and has contracted for 25,000 horsepower more, to be taken, 15,000 on or before July 1, 1917, and 10,000 on or before July 1, 1918. The contract also gives the Shawinigan Water & Power Company an option to July 1, 1918, on an additional 37,500 horsepower and a further option on 12,500 horsepower more under option to the Laurentide Paper Company. The latter company is using 25,000 horsepower from the Laurentide Power and has the above option for $12,500 more. Contracts with both companies are for 50 years. The net income to Laurentide Power from these contracts alone, without considering revenue from the 50,000 horsepower under option, will be nearly twice its bond interest and the strength of the two contracting companies is indicated by the market value of their capital stock, which exceeds $35,000,000. The closed bonded debt of the company is $60 per horsepower, a figure lower than that of any similar hydroelectric development of the present day. Through a sinking fund about half of the issue will be redeemed before maturity. On or after January 1, 1920, the company may redeem the entire issue on three months' notice at 105 and interest on any interest date.

Dividends.

	Term	Rate	Payable
Am. Gas & Elec., com	Q	2.5 %	Oct. 2
Am. Gas & Elec., pf	Q	1.5 %	Nov. 1
Am. Pw. & Lt., pf	Q	1.5 %	Oct. 2
Am. Pub. Util., pf	Q	1.5 %	Sept. 30
Asheville Pw. & Lt., pf	Q	1.75%	Oct. 2
Bell Tel. of Canada	Q	2 %	Oct. 14
Capital Traction, Wash.	Q	1.25%	Oct. 1
Carolina Pw. & Lt., pf	Q	1.75%	Oct. 2
Cin. & Ham. Trac., com.	Q	1 %	Oct. 2
Cin. & Ham. Trac., pf	Q	1.25%	Oct. 2
Cin. & Sub. Bell Tel.	Q	2.5 %	Oct. 2
Cleveland Ry.	Q	1.5 %	Oct. 2
Col. Ry., Pw. & Lt. Ser. A. pf.	Q	1.5 %	Oct. 2
Consum. Pw. (Mich.), pf.	Q	1.5 %	Oct. 2
Duquesne Lt., pf.	Q	1.75%	Nov. 1
East. Pw. & Lt., pf.	Q	1.75%	Sept. 15
Elmira Water, Lt. & R. R., first pf.	Q	1.75%	Sept. 30
Halifax Rys.	Q	2 %	Oct. 2
Honolulu R. T. & Land.	Q	2 %	Sept. 30
Houghton Co. Trac., pf.	S	$3.00	Oct. 2
Illinois Traction, pf.	Q	1.5 %	Oct. 1
Mass. Ltg., old com.	Q	$1.75	Oct. 16
Mass. Ltg., new com.	Q	25c	Oct. 16
Mass. Ltg. pf.	Q	$1.50	Oct. 16
Narrag. Elec. Lt.	Q	$1.00	Oct. 2
Natl. Gas, Elec. Lt. & Pw., pf.	Q	1.5 %	Oct. 2
Natl. Gas, El. Lt. & Pw.	Q	1 %	Oct. 2
Niagara Falls Pw.	Q	$2.00	Oct. 14
No. Ohio Trac. & Lt., pf	Q	1.5 %	Oct. 2
Ohio State Tel., pf.	Q	1.75%	Sept. 30
Ottawa Lt., Heat & Pw.	Q	1.5 %	Oct. 1
Penn. Water & Pw.	Q	1.25%	Oct. 1
Phila. Co., com.	Q	1.75%	Nov. 1
Phila. Co., cum. pf.	S	3 %	Nov. 1
Southern Util., pf.	Q	1.75%	Oct. 2
Toronto Rys.	Q	2 %	Oct. 2
Utah Pw. & Lt., pf.	Q	1.75%	Oct. 2
Wash., B. & A., pf.	Q	1.5 %	Sept. 30
Western Ohio Ry., first pf.	Q	1.75%	Oct. 2
Western Union	Q	1.25%	Oct. 16
Westinghouse A. B.	Q	$2.00	Oct. 21

Reports of Earnings.

INTERNATIONAL TRACTION.

International Traction Company of Buffalo, a subsidiary of United Gas & Electric Corporation, reported earnings as follows for 12 months ended July 31:

	1916	1915
Gross earnings	$7,440,627	$6,714,477
Net after taxes	3,272,491	2,758,495
Interest charges	1,905,612	1,843,762
Surplus	1,366,878	912,733
Preferred dividends	295,946	200,000
Renewal reserves	513,826	322,028
Balance	557,105	390,704

For July gross of the company was $731,992 compared with $611,086 for July, 1915, and the surplus for the month, after interest charges, was $107,050, compared with $116,074. After providing for preferred dividends and renewal funds this was at the annual rate of 13 per cent a year on the common.

New Incorporations

QUINCY, ILL.—The Ellington Electric Company has increased its capital stock from $25,000 to $50,000.

CHICAGO, ILL.—Electric Tractor Company. Capital, $20,000. Incorporators: R. MacRae, C. J. Schmidt and S. M. Ryan.

SUNRISE, MINN.—Sunrise Milling & Electric Company. Capital, $25,000. Incorporators: F. A. Spivak and A. H. Lindquist.

SPARTANBURG, S. C.—The Isolated Light & Power Company. Capital, $10,000. Incorporators: W. D. Burnett and G. E. Ladshaw.

INDIANAPOLIS, IND.—The Standard Electric Manufacturing Company. Capital, $100,000. Manufacture electrical devices. Incorporators: E. G. Applegate, D. A. Frew and B. F. Hall.

NEW YORK, N. Y.—G. & P. Electrical Supply House. Capital, $10,000. Electrical contracting and deal in lighting fixtures. Incorporators: S. Phillips, S. Garshelis and M. I. Garshelis, 1271 Hoe Avenue, the Bronx.

ARLINGTON, WASH.—The Washington Coast Utilities Company. Capital, $100,000. Manufacture electricity for municipalities and commercial industries. Incorporators: Warren Marshall and S. S. Philbrick, of Boston, Mass., and C. E. Shepherd, of Seattle, Wash.

Foreign Trade Opportunities

[Addresses may be obtained from the Bureau of Foreign and Domestic Commerce, Washington, D. C., or its offices at Boston, New York, Atlanta, Chicago, St. Louis, New Orleans, Seattle and San Francisco. Write on separate sheet for each item and give file number.]

NO. 22,380. CABLE.—An American consular officer in Norway writes that a man in his district desires to become agent of American manufacturers of vulcanized cable for electrical purposes. Catalogues and full information should be sent at once. The man states he can supply bank references.

NO. 22,394. MAGNETIC STEEL AND SHEET METAL.—An American consular officer in Switzerland writes that a firm in his district desires to be put in communication with American exporters of magnetic steel and dynamo sheet metal. Correspondence should be in German.

NO. 22,408. ELECTRICAL SUPPLIES.—The commercial agent of the Bureau in New York City reports a return visit to the United States of a Portuguese merchant who desires to purchase and pay cash in New York City for the following goods: Electric cables, seamless tubes for boilers, electric motors, and miscellaneous machinery and tools.

NO. 22,415. ELECTRICAL SUPPLIES.—The Bureau is in receipt of a communication from a business man in Java stating that he desires to communicate with American manufacturers and exporters of general electrical supplies and devices. Catalogues, price lists and full information should be sent.

New Publication

TORONTO HYDROELECTRIC SYSTEM.—The fifth annual report of the Toronto electric commissioners, who have charge of the hydoelectric system of the city of Toronto, Ont., has been published. It reviews the development of the city's system and gives a detailed report of operations during the year 1915. The gross income amounted to $1,620,187.60 and a net surplus, after all charges were allowed, was left of $3,137.79. The present rate per kilowatt-hour for residence lighting, commercial lighting and commercial power are respectively 2.86, 2.26 and 0.97 cents.

Electrical Patents Issued September 12, 1916

Prepared by Thomas Howe, Patent Attorney, 2 Rector Street, New York, N. Y.

1,197,620. Burnishing Machine. F. M. Furbee, assignor to United Shoe Machinery Co., Paterson, N. J. Has an electric toolheater.

1,197,628 Regulation of Electrical Distribution Systems. P. C. Hewitt, assignor to Cooper Hewitt Electric Co., Hoboken, N. J. Single-phase mercury-vapor rectifier kept alive by reactance operating at double frequency.

1,197,629. Vapor Electric Apparatus. P. C. Hewitt, assignor to Cooper Hewitt Electric Co. Source of ultra-violet rays employing thallium vapor.

1,197,659 and 1,197,660. Insulator Support. C. L. Pierce, assignor of one-half to Hubbard & Co., Pittsburgh, Pa. First patent: sheet-metal bracket for pin insulator. Second patent: modification.

1,197,686 and 1,197,687. Vapor Electric Apparatus. P. H. Thomas, assignor to Cooper Hewitt Electric Co. For rectifying single-phase current.

1,197,691. Apparatus for the Control of Highway-Crossing Signals. H. A. Wallace, assignor to Union Switch & Signal Co., Swissvale, Pa. Details of system having sectioned rails adjacent crossing.

1,197,705. Incandecent Electric Lamp. R. Winne, assignor to General Electric Co., Schenectady, N. Y. Tungsten lamp contains potassium thallium chloride and nitrogen at special pressure.

1,197,728. Casing for Engine Starter and Lighting Unit. F. E. Fisher, Detroit, Mich. Details of casing for motor and generator.

1,197,736. Coin-Holder. W. P. Hartford and C. M. Rickoff, assignor of one-third to said Hartford, one-third to W. T. Darden and one-third to A. P. McPherson, Chicago, Ill. Details of device having lamp illuminating indicator controlled by deposited coin.

1,197,737. Method of Applying Active Material to Secondary-Battery Plates. G. W. Hayden, assignor to Gould Coupler Co., New York, N. Y. Material pressed into grid by rollers.

1,197,747. Apparatus for Governing the Speed of Railway Cars or Trains. C. H. Lay, assignor to Union Switch & Signal Co., Swissvale, Pa. Block-signal system.

1,197,749. Railway Signaling. R. A. McCann, assignor to Union Switch & Signal Co. For single track road with turn-outs.

1,197,800. Starting Switch. C. F. Cuno, assignor to Cuno Engineering Corporation, Meridian, Conn. Details of inclosed, plunger-operated device.

1,197,812. Illuminating Fixture. H. A. Framberg, assignor to H. A. Framburg & Co., Chicago, Ill. Hood has translucent, adjustable bottom portions.

1,197,816. Electric Accumulator. G. Fuller, L. Fuller and G. J. Fuller, Bow, London, England. Details of storage-battery electrode of sectional block form.

1,197,819. Key-Operated Electric Switch. M. Guett, assignor to Hart & Hegeman Manufacturing Co., Hartford, Conn. Flush switch operated by means of an insertible key.

1,197,829. Quartz Lamp. F. G. Keys, assignor to Cooper Hewitt Electric Co. Details of tube structure for vapor electric apparatus.

1,197,830. Terminal for Electric Apparatus. F. G. Keys, assignor to Cooper Hewitt Electric Co. Leading-in structure for vapor electric apparatus.

1,197,835. Alternating-Current Hoist. D. L. Lindquist, assignor to Otis Elevator Co., Jersey City, N. J. Direct-current dynamo driven from main line supplies current to controlling magnets of alternating motor driving skip hoist.

1,197,853. Push-Button Connection for Electric Switches. C. D. Platt, Bridgeport, Conn. Details of push button and switch lever.

1,197,862. Signaling Device. D. M. Scott, Kansas City, Mo. Details to gearing between operating motor and signal arm.

1,197,872. Electric Comb. A. C. Taylor, Richmond, Va. Details of structure comprising electric heater.

1,197,910 Electrical Sound-Producing System and Apparatus. E. E. Clement, Washington, D. C. Tuned pipes or horns have magnetic vibrators selectively controlled by music roll.

1,197,926. Electric-Switch Button. M. C. Frank, Piedmont, Cal. Has translucent cap covering luminous material.

1,197,942. Railway-Traffic-Controlling Apparatus. L. V. Lewis, assignor to Union Switch & Signal Co., Swissvale, Pa. Car-speed control operated by a series of track trips.

1,197,954. Ground Terminal. A. R. Rheinberger, St. Paul, Minn. Structure of connection with earth.

1,197,957. Inclosed Fuse-Connector. J. Sachs, Hartford, Conn. Fuse has means adapting it for testing or switching purposes. (See cut.)

1,197,962. Lighting Fixture. E. M. Smith, Chicago, Ill. Semi-indirect.

1,197,969. Electropneumatic Apparatus. K. W. Thalhanner, Los Angeles, Cal. Valve-operating device.

1,197,970. Trolley Retriever. P. Thibodeau, assignor of one-half to D. H. Young, Willimansett, Mass. Compressed-air device at base of pole.

1,197,978. Electromedical Apparatus. J. J. Warner, Parkersburg, W. Va. Unitary device having motor-generator set, commutator producing alternating from direct current, voltage control rheostat, hand holds, etc.

1,197,989 and 1,197,990. Automatic Telephone System. C. S. Winston, asignor to Kellogg Switchboard & Supply Co., Chicago, Ill. Special provisions for operating release relay of automatic switch.

1,197,999. Supporting Device for Telegraph Lineman. E. L. Beckett, Mount Olivet, Ky. Adjustable stand for attachment to pole.

1,198,005. Toll-Telephone System. A. E. Case, assignor to Delta Electric Co., Marion, Ind. Automatic metering system wherein the meter does not register if the subscriber is cut off.

1,198,018. High-Voltage Outlet Structure. C. LeG. Fortegsne, assignor to Westinghouse Electric & Mfg. Co. Transformer housing, connections and insulation.

1,198,021. Power-Actuated Switch-Control System. G. B. Gray, Pittsburgh, Pa. For railways.

1,198,024. Electrolytic Apparatus. W. E. Greenawalt, Denver, Colo. Arrangement of electrodes and anolyte and catholyte containers.

1,198,028. Insulating Material and Process for Producing the Same. G. W. W. Harden, Le Roy, Minn. Sheet made of low-grade paper-pulp and unground stems of raw whole straw.

1,198,038. Electric Switch. C. J. Klein, assignor to Cutler-Hammer Mfg. Co., Milwaukee, Wis. Mechanism of snap switch including reciprocating bar having push buttons at its ends.

1,198,065. Lighting Apparatus for Railway Cars and the Like. L. Schepmoes, assignor to Safety Car Heating & Lighting Co., Jersey City, N. J. Ceiling light for sleeping cars.

1,198,066. Primary-Battery Electrode. C. B. Schoenmehl, Waterbury, Conn. Negative electrode composed of compressed oxide of copper having a perforated reinforcing sheet.

1,198,070. Electric Musical Instrument. M. L. Severy and G. B. Sinclair, assignors to Choralcelo Mfg. Co. Piano has magnetic strings operated at will either magnetically or by hammers or both.

1,198,072. Magnetoelectric Machine for Combined Ignition and Illuminating Purposes. F. R. Simms, assignor to Simms Magneto Co., Bloomfield, N. J. Permanent magnet acts on ignition armature and electromagnet acts on armature for starting and lighting of automobile.

1,198,073. Electric Water-Heater. M. Simon, St. Louis, Mo. Special structural details of resistance heater for insertion in pipe line.

1,198,074. Electrical Connector. H. S. Sines, assignor to Mineraliac Co., Chicago, Ill. Conductor terminal.

1,198,080. Dynamoelectic Machine. C. W. Starker and G. L. S. Kronfeld, assignors to Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa. Casing and field frame of railway or automobile motor.

1,198,116. Electric-Arc Furnace. A. O. A. Dovle, assignor to Norsk Hydro-elektrisk Kvaelstofaktieselskab, Christiania, Norway. Structure of gas-light joint where movable electrode passes through furnace wall.

1,198,119. Safety Device for Moving-Picture Machines. B. Garros, assignor of 25/100 to C. T. Bush, 25/100 to C. E. Allinger 25/100 to C. A. Sterlinger and 25/100 to M. E. Jones, Detroit, Mich. Trip mechanism for switches in motor and light circuits controlled by film.

1,198,131. Insulator. R. P. Jackson, assignor to Westinghouse Electric & Mfg. Co. Mounting and structure of superposed insulating members with petticoats.

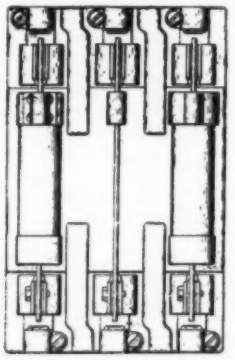
1,198,137. Insulator. P. M. Lincoln, assignor to Westinghouse Electric & Mfg. Co. Suspension type. (See cut.)

1,198,147. Warning Signal. A. N. Pierman, Newark, N. J. Horn operated by pneumatic hand-bulb or by contacts closed when bulb is fully compressed.

1,198,158. Automatic Train-Stopping Apparatus. W. A. Seeds, Cripple Creek, Colo. Details of contact shoe.

1,198,161. Spark-Plug. J. J. Smith, Benton Harbor, Mich. Details of structure with automatic contact-cleaner.

1,198,177. Railway Signaling Device. E. S. Wright, New York, N. Y. Coupling devices between cars for circuit of signal on locomotive.



No. 1,197,957.—Inclosed Fuse-Connector.

1,198,193. Fuse-Plug. T. F. Cote, Prince Albert, Saskatchewan, Canada. Structural details.

1,198,212 and 1,198,213. Telephone Repeater. E. Grissinger, assignor to American Telephone & Telegraph Co., New York, N. Y. First patent: Special magnetic device for operating microphone electrodes. Second patent: Modification.

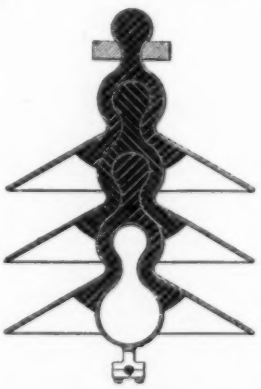
1,198,214. Telephone System. E. Grissinger, assignor to American Telephone & Telegraph Co. Two-way talking telephone repeater system.

1,198,221. Signaling and Indicating Device for Heating Plants. A. Hein, Berlin, Germany. Thermometer controls indicating drop which acts on clock to show time.

1,198,235. Alternating-Current Motor. H. W. Jeanin, Warren, O. Details of centrifugal device on rotor.

1,198,239. Electric Flashlight. H. M. Koretsky, New York, N. Y. Resembles a watch.

1,198,250. Commutator-Assembling and Finishing Device. J. Moles, Erie, Pa., assignor to Eureka Co., North East Pa. Details for gripping and holding bars.



No. 1,198,137.—Insulator.

1,198,268. License-Number Holder for Automobiles. C. F. Peterson and A. Finney, East Boston, Mass. Special electrically lighted structure.

1,198,270. Apparatus for Utilization of Signal Currents for Telegraphic, Radio-Telegraphic or Other Purposes. V. Poulsen, Frederilsberg, Denmark. Recorder controlled by variation of liquid jet to which variable potentials are applied.

1,198,323. Tail-Lamp. C. M. Bullock and J. T. Wickersham, Bardstown Junction, Ky. Arrangement of reflectors, color screen, lamps, etc.

1,198,340. Electric Contact-Making Device. E. Garretson, assignor of one-third to H. Osgood, Holland, Buffalo, N. Y. Contact structure for simple push button.

1,198,345. Telephone Transmitter. E. Grissinger, assignor to American Telephone & Telegraph Co., New York, N. Y. Variable resistance electrode has high natural frequency imposed upon it.

1,198,349. Method of Making Wire-Mesh Fabric. J. A. Heany, assignor to Patents Experiment Corporation, New York, N. Y. The longitudinal and cross wires are electrically welded in the form of a tube which is then split lengthwise.

1,198,350. Method of Insulating Small Conductors. J. A. Heany, assignor to Patents Experiment Corporation. Fine wire is covered with a fibrous sheath.

1,198,351. Apparatus for Making Wire-Mesh Fabric. J. A. Heany, New York, N. Y. Machine for performing operation of No. 1,198,349.

1,198,356. Apparatus for Catalyzing the Synthesis of Organic Substitution Products. F. G. Keys, assignor to Cooper Hewitt Electric Co., Hoboken, N. J. Includes a mercury-vapor tube.

1,198,364. Spark-Plug. G. J. Knutson, White Salmon, Wash. Details of special electrode structure.

1,198,364. Fuse. H. H. McLaughlin, Knoxville, Tenn. Structural details of cartridge fuse.

1,198,376. Thermostatic Switch or Cutoff. W. B. C. Porter, assignor of one-half to T. Robb, Kennett, Mo. Pressure-operated switch mechanism.

1,198,381. Vapor Electric Apparatus. P. C. Hewitt, assignor to Cooper Hewitt Electric Co. Structure of rectifier.

1,198,385. Attachment for Trolley Poles. J. W. Oman, St. Louis, Mo., assignor of two-thirds to W. Sacks, St. Louis, Mo. Spreading wire-finding arms controlled by trolley rope.

Reissue 14,191. Automatic Control for Printing Presses. S. L. Tucker, assignor to A. B. Huey, Philadelphia, Pa. Original No. 1,095,751, filed Aug. 9, 1912. Throw-off electromagnetically tripped on failure of sheet feed.

PATENTS EXPIRED.

The following United States electrical patents expired on September 19, 1916:

633,146. Combined Generator and Ringer for Telephone. J. G. Nolen, Cleveland, O.

633,147. Tablet and Index. J. G. Nolen, Cleveland, O.

633,164. Electrotherapeutic Bath. H. Stanger, Ulm, Germany.

633,165. Device for Feeding Current to Electrically Driven Cars. C. F. P. Stendebach, Leipsic, Germany.

633,166. Electric Railway. C. F. P. Stendebach, Leipsic, Germany.

633,172. Rheostat, C. Wirt, Philadelphia, Pa.

633,173. 633,174. 633,175 and 633,176. Insulator. F. H. Withycombe, Montreal, Canada.

633,182. Adjustable Crossover for Electric Wires. J. E. Blakesley, Chicago, Ill.

633,213. Wire Fence-Making Machine. J. C. Perry, Clinton, Mass.

633,214. Machine for Electrically Welding Wire Fabrics. J. C. Perry, Clinton, Mass.

633,218. Weighing Machine. F. H. Richards, Hartford, Conn.

633,219 Thermostat Valve. G. Scarfe, Towanda, Pa.

633,223. Electromedical Apparatus. W. P. Sutton, Toronto, Canada.

633,246. Device for Lighting Lamps by Electricity. S. M. Meyer, New York, N. Y.

633,272. Process of Manufacturing Chlorates by Electrolysis. T. Parker, Tettenhall, England.

633,275. Means for Electric Ignition for Vapor Engines. C. C. Riotte, New York, N. Y.

633,385. Means for Transmitting Power from Axles to Podies of Railroad Cars. L. T. Mann, Chicago, Ill.

633,403. Telephone-Exchange Switchboard Signaling Apparatus. T. C. Wales, Jr., Newton, Mass.

633,432. Combined Telephone Desk and Directory Support. S. H. Dodd, Jeannette, Pa.

633,471. Weight and Pressure Indicator. E. McGarvey, Bellefonte, Pa.

633,478. Combined Electric Motor and Pump Head. R. J. Northam and G. E. Nolan, Los Angeles, Cal.

633,494. Electric Railway Signal. J. Shoecraft, Topeka, Kans.

633,516. Centrifugal Electric Switch. R. L. Hunter, Minneapolis, Minn.

633,544. Electrolytic Apparatus for Precipitating Metals. H. S. Badger, Denver, Colo.

633,547. Telephone System. W. M. Davis, Chicago, Ill.